THE

# JOURNAL

OF

# THE ASIATIC SOCIETY

OF

# BENGAL.

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VOL. I.

THE

# JOURNAL

OF

# THE ASIATIC SOCIETY

OF

# BENGAL.



EDITED BY

JAMES PRINSEP, F. R. S.

SECRETARY OF THE PHYSICAL CLASS, ASIATIC SOCIETY.

VOL. I.

JANUARY TO DECEMBER,

**1832.**

"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science, in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta; it will languish, if such communications shall be long intermitted; and it will die away, if they shall entirely cease."

SIR WM. JONES.

Calcutta:

PRINTED AT THE BAPTIST MISSION PRESS, CIRCULAR ROAD.

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1832.

TO

# CAPTAIN JAMES D. HERBERT,

## Bengal Infantry,

LATE

DEPUTY SURVEYOR GENERAL OF BENGAL, AND SUPERINTENDENT OF REVENUE SURVEYS;

AT PRESENT HOLDING THE APPOINTMENT OF

ASTRONOMER TO HIS MAJESTY

## The King of Oude:

WHOSE JUDGMENT ORIGINATED; WHOSE PERSEVERANCE AND EXERTIONS SUCCESSFULLY ESTABLISHED; AND WHOSE SUPERIOR ABILITIES SUPPORTED FOR 3 YEARS,

THE FIRST JOURNAL

IN INDIA

DEVOTED TO THE EXCLUSIVE PUBLICATION

OF

## GLEANINGS IN SCIENCE;

THIS VOLUME,

IN ALL RESPECTS, BUT TITLE, A CONTINUATION OF HIS OWN WORK,

IS

## Inscribed,

BY HIS ATTACHED FRIEND,

THE EDITOR.

CALCUTTA,
*January* 1, 1833.

# PREFACE.

The Asiatic Society, on the 7th March, 1832*, passed a resolution, that the monthly journal hitherto published under the name of "Gleanings in Science," should be permitted to assume that of Journal of the Asiatic Society, and to continue it as long as the publication remains under the charge of one or both of the Secretaries of the Society. This privilege has, as it was anticipated, been the means of extending very considerably its circulation, while it has given a character and authenticity to the work, by its connection with an institution of established literary reputation, which no anonymous magazine, however well conducted, could hope to command.

The advantages of extended circulation have reacted to the benefit of subscribers, by enabling the Editor to increase the quantity of letter press from 400 to nearly 600 pages; and yet so constant has been the growing support of its contributors, that the pages of the Journal have been devoted, with few exceptions, to the insertion of original communications.

To many readers it would doubtless have been preferable that the Journal should contain more copious extracts from English scientific periodicals, which are not procurable in the interior of India; but conceding that, as an organ of Indian scientific intelligence, it must obviously derive its only merit among the many similar periodicals of the present day, from its stores of *oriental* literary and physical research, it will be generally acknowledged, that the first object of the work should be to give publicity to such oriental matter as the antiquarian, the linguist, the traveller, and the naturalist may glean, in the ample field open to their industry in this part of the world. While acting

* The January number was not published until the middle of March.—Since then exertions have been made to bring up arrears, and in future each monthly number will appear with regularity on the 10th of the following month; the insertion of the meteorological register rendering an earlier issue impossible.

on this principle, however, the Editor has not lost sight of the great utility of following, as far as means would permit, the progress of the various sciences at home, especially such as are connected in any way with Asia; the only limits thereto being want of space, and want of time to peruse and extract from the vast number of publications of the present day. Want of room also precluded the possibility of republishing the proceedings of the Medical and of the Horticultural Societies; but this had become less urgent since both of those useful bodies adopted the excellent rule of giving early publicity to their own proceedings and records.

To the Asiatic Society THE JOURNAL has naturally looked for its most frequent and interesting communications; and in consequence of its more intimate connection with that Institution, the proceedings of that body have been given in greater detail than heretofore, so that absent members may learn exactly what passes at its meetings, and what accessions are made from time to time to its library and its museum. Many absent members have complained of the quarterly subscriptions they were heretofore called upon to pay, while they remained in ignorance of what was going forward; this source of objection is now obviated, and perhaps a still greater amendment may yet be effected for their benefit, by an arrangement that all members of the Society shall receive a copy of the Journal gratis, which will reduce their annual payments nearly one fourth.

It is unnecessary to recapitulate the contents of the present volume, or to allude in anonymous praise to those who have favored its pages with their assistance; since the authors have, in most cases, on suggestion, permitted their writings to be authenticated by the insertion of their names, as should always be the case in matters of fact, observation, and research. One illustrious name however must not be passed over without a tribute of gratitude for its valued and frequent contributions, a tribute more sincerely paid, since India has now lost the power and the claim to their continuance; she has resigned her most eminent oriental scholar to climes where his talents may find more genial appreciation, but where they cannot excite more respect or admiration, than they will ever command in the land which called forth their energies and directed their application.

The learned Societies at home will be proud to publish the continuation of the *Analyses of the Puránas*, of which the four first have appeared in these pages. Abstracts of four only were ready for the press, but translations of the remainder of the eighteen *Puránas* themselves had been completed under the superintendence of Professor Wilson, before he quitted India.

Mr. Alexander Csoma's indefatigable labour, in opening to us a first acquaintance with the literature of Tibet, will be estimated as it deserves by literary men—a contracted circle perhaps, because deep erudition and study are requisite to form critics capable of appreciating the nature and bearing of his peculiar researches upon the history, languages, and religions of other nations, both ancient and modern. All may however feel sensible of the devotion, zeal, and perseverance, which are necessary to lead a man, alone and unpaid, into a distant and wild country, to learn its language, and study its people at the fountain head. The volumes of notes which Mr. Csoma has presented to the Asiatic Society, will, it is hoped, be published in their Researches at length.

In furtherance of the desire of the Government, the greater part of Dr. Buchanan's Statistics of Dinajpúr has been printed in a detached form, as commenced by the Editor of the GLEANINGS; and to complete the work more speedily, two extra numbers have been issued in the course of the year. It will be remarked, that there are many plates referred to in the text: the drawings alluded to are in possession of the Honorable Court of Directors, along with the original manuscripts; it was thought better to preserve the references, in case the Hon'ble Court might hereafter be persuaded to publish them, either in a separate form, or of a size adapted to the present edition. It must not be forgotten, that it is this undertaking which gained to the GLEANINGS the valuable privilege of free postage through the Bengal Presidency. The Editor is happy to announce, that the same boon has, in the most liberal manner, and without any solicitation, been extended to the Presidency of Bombay and to the Government of Ceylon, by their enlightened Governors, His Excellency the Earl of CLARE, and the Right Honorable Sir R. W. HORTON, to whom his thanks are thus publicly and respectfully addressed.

To his numerous correspondents, the Editor can but proffer thanks for past, and solicitations for future, support, bidding them remember that, the scope and object of this publication embraces the literature, the manners, the geography, physical and mineral, the arts, the natural productions of Asia, the phenomena of its climate, and observations of the heavens. In the words of the illustrious founder of the Asiatic Society, " the bounds of its investigation will be the geographical limits of Asia; and within these limits its inquiries will be extended to whatever is performed by man or produced by nature."

*Dedicated, by permission, to*

LADY W. C. BENTINCK,

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A

# TREATISE

ON

# THE MUSIC OF HINDOOSTAN,

COMPRISING A DETAIL OF

## THE ANCIENT THEORY

AND

## MODERN PRACTICE.

---

THE similarity of the music of Egypt and Greece to that of this country has been traced and pointed out: harmony and melody have been compared: and time noticed. The varieties of song have been enumerated, and the character of each detailed: a brief account of the principal Musicians superadded, and the work concluded with a short alphabetical glossary of the most useful musical *Terms*.

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BY

CAPTAIN N. WILLARD,

*Commanding in the Service of H. H. the Nuwab of Banda.*

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*Price to Subscribers, Sa. Rs.* 8.

# PROSPECTUS.

A TREATISE on the Music of Hindoostan was much wanted. The scanty information obtainable through the channels of Dr. GILCHRIST and Sir WILLIAM JONES, are neither of themselves sufficient to fill this chasm, nor do they elicit light sufficient to enable one to grope through the various obscure writings in the vernacular languages and dialects. The songs set to music by Mr. BIRD and Mr. WALKIER, are of the more modern style, and not of the ancient school; so that, instead of elucidating the theory, they lead us into confusion, when compared with the tables of Rags and Raginees given by Sir W. JONES.

The forthcoming work has been written with the view of describing in some measure, the theory and practice of the original music of Hindoostan, but chiefly to unfold the beauties of which it is susceptible. The extravagant eulogium offered to the music of ancient Greece, and the striking similarity which appeared to the author to exist between that and the subject to be treated of in this work, has led him to point them out, in the hope that, should a taste for the music of this country obtain among the professors of the science in Europe, it might perhaps conduce to the elucidation and revival of a much-desired and lost branch of knowledge, namely, the music of ancient Egypt and Greece.

For this purpose it appeared to the author, that a bare translation of any of the existing native works would not suffice. All who have been taught music are so much accustomed to the European way of explaining it, that every other must necessarily appear uncouth and preposterous. In the arrangement of this work, therefore, the European system has been adopted.

## CONTENTS.

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N. B. *The work will be printed on superior English paper, at the Baptist Mission Press, Calcutta.*

Subscriptions will he received hy Mr. A. Jewell, Moorghehuttah, and Messrs. Thacker and Co. St. Andrew's Library.

# CONTENTS.

## No. 1.—JANUARY.



## No. 2.—FEBRUARY.



## No. 3.—MARCH.

No. 4.—APRIL.



No. 5.—MAY.

## DIRECTIONS TO THE BINDER.

The sheets of Buchanan's Statistics are to be separated from the monthly numbers. The Plates may either be bound up at the end of the volume, or in the following order :

# ERRATA.

Page 10 line 9 *for* "wool," *read* "wood."
—— 11 — 7 *from bottom, for* "plate 1, fig. 2," *read* "plate 2, fig. 1."
—— 14 *last line, for* "delomite," *read* "dolomite."
—— 19 — 16 *from bottom, for* "3, 4, 5," *read* "1, 2, 3, 4."
—— 20 — 8 *from top, for* "plate 1," *read* "plate 2."
—— 20 — 9 *for* "he protracted," *read* "the protracted."
—— — — 11 *for* "BB″ B′," *read* "B″ B′."
—— — — 16 *for* "intercepts," *rsad* "intersects."

AND

*In Fig* 2, *plate II.* continue the dotted arc 1′ 1 *a″* to *a′*.
The line A *c′* continue to *c*.

—— 28 — 7 *from top, for* "manima," *read* "minima."
—— — *at bottom, for* "Artesien," *read* "Artesian."
—— 33 — 7 *for* " January," *read* " February."
—— 410 — — *in last column* of Table II. *for* "2m. 58s. 8," *read* "0m. 58s. 8."
—— 46 — 18 *from top, after* "which" *insert* "comma."
—— — — — ———————— "either" ditto.
—— 47 — 2 *from top, for* "have," *read* "has."
—— 57 — 12 *for* "$99\frac{1}{4}$ $99\frac{1}{2}$ $99\frac{3}{4}$," *read* "$99^1$ $99^2$ $99^3$."
—— 59 — 24 *and throughout the article, for* " sack," *read* "sac."
—— 60 — 4 " orbitar," *read* " orbital."
—— — — 10 " interval," *read* "internal."
—— — — 29 " lips," *read* "tips."
—— — — 34 *dele* "by."
—— 60 — 15 *for* "compressed and hard; before," *read* "compressed and hard before ;"
—— — — 28 *for* " lips," *read* " tips."
—— 62 — 11 *for* "this Chiru," *read* " the Chiru."
—— 63 — 10 *for* "bambdoidal," *read* " lambdoidal."
—— — — 14 *for* " malars," *read* " molars."
—— 65 — 8 *for* "$1\frac{1}{8}$," *read* "$\frac{3}{1\,6}$."
—— 67 — 2 *from bottom, after* "than," *read* " the."
—— 74 — 15 *for* "9°," *read* "$9^h$."
—— 75 — 21 *dele* "rufous," repeated.
—— 79 — 17 *from bottom, for* " done," *read* "donc."
—— 148 — — *foot note, for* " Rutboo," *read* " Kubboo."
—— 226 1st par. 5th line *for* " Ekadantashtra," *read* " Ekadanshtra,"
—— 226 4th „ 4th — *for* "Kridama," *read* "Srid'ama"
—— 229 2nd „ 5th — *for* "Vrishapati," *read* "Vrihaspati."
—— 231 — „ 3rd — *for* "Viswaséna" *read* " Viswakerma."
—— 238 — „ *after* " Ganges river," *insert* " at Gházipur."
—— 245 10 „ *from bottom, for* "it," *read* " the mirror."
—— — 1st „ 7th — *for* "He having," *read* " Having."
—— 296 line 3 *for* " but mostly," *read* "and,—"
—— — — 7 *for* " hydrogen. When," *read* "hydrogen, where."
—— 305 — 20 *for* " circumference," *read* "diameter."
—— — — 21 *for* "$27\frac{1}{2}$ rupees," *read* "$2\frac{1}{2}$ rupees."

*Errata in Meteorological Register, for June.*

| Date | Hour. | | Bar. | | |
|---|---|---|---|---|---|
| 13 | Sun-rise, | *for* | ,365 | *read* | ,465 |
| 14 | ,, | | ,399 | | ,499 |
| 22 | ,, | | ,517 | | ,617 |

Add 0,010 to all the figures in the Barometrical column for 10½ P. M.

—— 340 — 6 *after* "*Rhinolphus*," *insert* "and two species of *Vespertilio*."
—— 355 — 13 *for* "ακανσα," *read* "ακανστα."
—— 355 — 2 *from bottom, after* "*nilam*," *insert* "*nîl mani*, (or *manik*.)"
—— 356 *after* "College of Fort William," *insert* "the word *bahrmani* is also used in the *Khawás-ul* [illegible]*ár*, as a variety of the *yaqút*."
—— 358 — 20 *dele* "or a species of garnet."
—— 358 — 22 *for* "*manik*," *read* "*lâlri*."
—— 403 — 5 *from bottom, for* "ΔΙΟΚΛΠ," *read* "ΔΙΟΚΛΗ."
—— 404 — 14 *for* "ΟVΑ," *read* "ΟΥΑ."
—— 411 — 8 *for* "Latitude 25° 43′," *read* "Lat. 25° 47′ 26″."

In Table IV. of the Estimate of Life in India, page 284, the first four figures in the second and third column should stand thus:

| Age. | Survivors. | Deaths. |
|---|---|---|
| 20 | 52221 | 473 |
| 21 | 51748 | 489 |
| 22 | 51259 | 522 |
| 23 | 50737 | 557 |

The mistake arose from the calculations having originally been made to commence with the age of nineteen, instead of twenty: and the 5 year averages in Table III. page 283, will all be slightly affected by the same cause. The last figure in the second column, page 284, should be reversed; and in the last column but one, *for* "2080," *read* "2008."

Line 414 line 3 *from below, for* "molluscæ," *read* "mollusca."
—— 444 — 36 *after* "ministry," *insert* "of a man."
—— 445 — 3 *from below, for* "2125," *read* "212.5."
—— 446 — 7 *for* "in bullion," *read* "bullion."
—— 447 — 21 *for* "will be," *read* "would be."
—— — — — *after* "at any," *insert* "rate."
—— 480 — 15-16 *for* "Tariqa-i-Chishita," *read* "Tarîqa-i-Chishtia."
—— 483 — 36 *for* "lost about," *read* "tost about."
—— — — 39 *for* "Mújtahid-i-mústuqill," *read* "Mújtahid-i-mústaqill."
—— 485 — 20 *for* "Taqwiat-ul-Imám," *read* Taqwiat-ul-Imán."
—— 487 — 15 *erase* "5" at beginning of line.
—— 488 — 7 *for* "differences," *read* "difference."
—— 489 — 20 *for* "Káfr," *read* "Kufr."
—— 491 — 23-24 *for* Ishrák f'il Tasarraf," *read* "Ishrák f'il Tasarruf."
—— 492 — 10-11 *for* "the authority or influence of Saints, as respecting intercessors," *read* "respecting the authority or influence of Saints as intercessors."
—— 498 — 23 *for* "Khátim," *read* "Khátima."
—— 501 — 12 *after* "A B C," *insert* "[fig. 5.]"
—— 505 — 20 *for* "5 53 59," *read* "5 52 59."
—— 506 — 11 [illegible] "5 53 10," *read* "5 53 27."

# JOURNAL

OF

# THE ASIATIC SOCIETY.

## *No.* 8.—*August*, 1832.

### I.—*Progress of Indian Maritime Surveys.*

Amongst the events of scientific interest which have recently been announced in India, is the institution in England of a new Society, having for its object the promotion of Geographical Science, and called the Royal Geographical Society. Mr. Barrow, the reputed author of many valuable articles in the *Quarterly Review*, illustrative of the Geography of various parts of the world, and the adviser of those expeditions into the Arctic Seas, from the success of which in exploring the northern coasts of the American continent, so much credit has redounded to the British nation, is the President of this Society; and certainly, since the death of our own Major Rennell, there is no one whose reputation stands so high in this department of science, or whose zeal, acuteness, and rare tact in the discrimination of the value of materials promise more for the success of an association devoted to such objects. There has been issued already one number, containing the first fruits of the Society's labours; and the interesting papers it contains, added to the style of elegance and correctness in which the maps are executed, make us wish anxiously to see the continuation.

There is no branch of science so proper as geography to be taken up by an Association of this kind, because there is none in advancing which pure study and literary research can do so little, and the progress of which depends so much upon the accidental circumstances in which men of various attainments happen to find themselves placed. For nearly all that has been done, and for most that is still doing in geography, by land or by sea, we are indebted to the exertions of practical unpretending individuals, who finding the maps and charts they are using incorrect, or lighting by chance on new objects not laid down, employ a

few leisure days in examining and noting what they thus illustrate or discover. Each in this way adds his little mite to the store of knowledge already accumulated, and, without the authentic record afforded by the published proceedings of a Society, these contributions might be withheld altogether from the world, or might fall into the hands of those who would misuse them. Henceforward the publications of this useful institution will afford a certain means of tracing discoveries to their source, and of ascertaining upon what authority additions are made in successive Maps and Charts. The compiler and publisher who has set his name ostentatiously in the corner, has too often hitherto got the credit for all the improvements introduced; while the adventurous voyager who has discovered, and the surveyor whose superior skill has delineated and assigned the true position to objects, have been defrauded of the fame which is their just due. The observation holds equally whether the addition to geographical knowledge be the result of measures taken by a Government officer, with the specific object of ascertaining or verifying a point, or of individual enterprise directed by zeal, or by accident, into this line of science. For, with exception to the large general surveys undertaken by Governments for military or for fiscal purposes, the results of which are given to the world, each with the pretension of out-doing all that has gone before, but of which the great expence must make the instances rare, the improvements effected by Government officers, are, like those by individuals, of isolated locality; and when the point has been ascertained, the result is incorporated in some general chart, and the time and manner of the survey is soon forgotten, or known only to those who from curiosity or from official duty may happen to be employed in ransacking the archives of state offices. For these reasons we look upon the establishment of a Society devoted especially to geographical science to be a most useful institution; and we hope that all who are engaged in the same pursuit, and who may become possessed of materials, or be placed in circumstances to be able to contribute any thing towards the advancement of this science, will furnish their results to the new Association, that they may be there digested and compared and verified, and so be turned to account, according to their value, in leading to a more accurate knowledge of the earth's surface—every advance made to this object being set down to the credit of the right owner.

The field of geographical inquiry is still a very wide one. The interior of many continents remains blank in our latest maps. The coasts of others are set down as handed from chart-maker to chart-maker without any recent verifications, and upon very doubtful original

authority, while of more than half the islands on the earth's surface we have no more accurate knowledge, than the fact, that they exist in clusters of uncertain number and position, and of very dangerous approach. Nay, even in the great high-ways of commerce and of navigation, there are rocks and sandbanks and other perils, as to the existence and locality of which the evidence is balanced with most perplexing equality. Such things ought not to be in this age of philosophical research, and in a department more especially which admits of exact ascertainment. We look to the labours of the new Geographical Society to dispel the mist of uncertainty which now covers so much of the earth's surface, and by little and little to bring out the whole in clear and well-defined and undisputed outlines. Those who aid in this work, may be assured of the approving cheer with which the results of their labours will be hailed by all classes and all nations ; for geography is a science, the benefit from advancing which none are so obtuse or so bigotted as not to acknowledge.

As a science, geography is entirely of modern growth. It has followed upon the advances made in the art of navigation ; and to this circumstance only can we ascribe, the comparative backwardness of the ancients in the department, and the little they have left that is of value in it. Before the discovery of the compass and the improvements made in the construction of ships, and the numberless inventions which have made navigation a means of access to the remotest corners of the far distant ocean, the geographer's materials were confined to itineraries, and the confused records of military expeditions, and of laborious land-journies. Then mountains and rivers, and interior seas, deserts and lakes, were the objects of first discovery. Now we have the coasts and outward appearance, and the entire size of a continent thoroughly ascertained and delineated before we know any thing whatsoever of the interior. With the advance of navigation came the necessity of providing the means of accurately knowing, whereabout on the earth's surface the winds and waves had carried the adventurous voyager. Hence the discovery of instruments for determining latitudes and longitudes with a precision before undreamt of, and hence the ability to assign a place on the general map of the earth's surface to every object that presented itself to the navigator's observation.

The refined and scientific surveys on land, undertaken for the correct determination of the earth's figure, would never have been set on foot but for the discoveries previously made by navigation. They are but an extension of that science, and are effected through an application of the same intruments and materials, though these are prepared and

used of course with much more elaborate care than for the common purposes of the practical voyager.

Seeing, therefore, how entirely dependent geography has been, and still is, and, for a long time to come, must be upon navigation, we learn to appreciate the labours of those marine surveyors and careful scientific navigators, through whom we have arrived at a correct knowledge of the positions of islands, and of the figure of continents, and of the bays and rivers, and rocks and sand-banks, which distinguish the shores of seas and oceans, and thus are enabled to compile a chart which shall accurately exhibit the phænomena of the earth's surface, and enable future voyagers to steer boldly to ports they have never before visited; astonishing the native inhabitants by the display of more information on the subject than they possess themselves.

There is nothing however more deceitful, or that ought to be received with more distrust than a chart or nautical survey, with the author of which and the materials of construction we are unacquainted. There is not a midshipman nor a captain's clerk in the mercantile navy that cannot take a latitude and a bearing, and with the help of the printed navigation tables, make an approximate calculation of the longitude. Nobody, therefore, that sails in a ship which happens to light upon strange lands, or upon objects of any kind not laid down in previous charts, fails to assign at once a locality to what he sees ; and if the time allows him to cast anchor, a chart is constructed from a series of bearings, and produced with as much confidence as if made from the best trigonometrical data. If the author of the discovery be a man of credit and intelligence, his chart is incorporated in those published to the world, and continues, with all its defects, to be given out as the best record possessed of the portion of the earth's surface delineated. This is exactly as it should be, and no one in his senses, would wish such information and materials to be suppressed ; but the difference is wide between the sketch of a casual voyager of this kind, put together from compass bearings, and logboard distances, and computed latitudes and longitudes, and the accurate delineation of the practised nautical surveyor employed to verify, and to ascertain once for all, the exact position and outline of what has been hitherto vaguely and imperfectly known and reported.

The Governments of British India are entitled to much credit, for the manner in which the means at their disposal have been employed in furthering the advance of our geographical knowledge, by surveys of this kind. The department has, in the seas to the eastward of the Indian peninsulas, been for many years under the direction and personal management of Captain Ross, Senior Commander in the Indian Navy, and Marine

Surveyor General to the Supreme Government. The reputation of this officer stands already too high to be affected by any commendations we might bestow upon the works he has produced. We look upon the charts as complete models in their kind, knowing them to be constructed with a care and a regard to scientific accuracy, creditable alike to himself, and to the Government, which approving his cautious methods, leaves him to prosecute his surveys as his own good sense may suggest, unembarrassed by minute instructions, and with merely the locality and direction of his investigations indicated beforehand. The result is, that charts are annually produced, which convert tracts of complete *terra incognita*, or coasts roughly laid down from the loose bearings and observations of casual voyagers, into lines of accurately defined and well delineated shore, with the mountains and highlands, the bays and harbours, the rivers and watering places, and all the towns or villages, within observation from the sea, correctly set down. Each of these charts is a new acquisition to geography, quite independent of the service done to navigation by laying down the real position and bearings of dangers, visible or hidden; and by enabling every nautical man, on approaching the coast surveyed, to know for certain where he is, and what course he should steer in prosecution of the voyage he has in hand.

A coast once laid down by the accurate methods pursued by Captain Ross, needs never to be surveyed a second time. Future investigators may complete what from circumstances may have been left by him imperfect. They may add a few new lines of soundings, but they will find nothing to find fault with or to require correction. Indeed, the confidence with which practical navigators, when once they come upon the ground included in his surveys, follow boldly his directions, and shape their course at pleasure, in the most intricate passages, is both a compliment to his industry and professional skill, and a proof of his well-earned reputation in the department.

Captain Ross was, we believe, first employed in surveying various portions of the China Seas, under the orders of the Court of Directors, issued as far back as in the year 1806. These surveys occupied him 14 years, and embraced all the most prominent dangers of the frequented passages of navigation to and from China, and all the most important coasts of that empire. The charts were separately published, as they were completed, but the whole were afterwards incorporated in the General Chart published by the hydrographer of the Company, and which bears Mr. Horsburgh's name.

In 1823, Captain Ross was appointed by the Court of Directors to his present office of Marine Surveyor General. His operations were necessarily interrupted during the Burmese war; but the following surveys have since been executed in succession under his superintendence, and mostly by himself personally.

1. The Rangoon river to its mouth.

2. The straits, approaches, and harbour of Singapore.

3. The Mergui archipelago, Tenasserim coast, and Martaban, with the river at Amherst and Moulmein. The sheets of this Chart cover a line of coast extending from Lat. 8°. 28′. N. to 16°. 32′. and include a vast number of Islands never before laid down or even visited by Europeans.

4. In the meantime, the coast of Ava from Negrais to Ramrí, and Sandowí, was surveyed by Captain Crawfurd, and Chedúba roads and Ramrí, by Captain Ross's assistant Lieut. Lloyd.

5. The coast of Arracan, north of the point to which Captain Crawfurd's Chart extended, was, in the past season, the object of Captain Ross's personal survey; and, in one or two seasons more, the entire eastern shore of the Bay of Bengal will have been laid down by this officer, or by those under his orders, with as much accuracy as can be claimed for the charts of the coasts of Europe and the Mediterranean.

All Captain Ross's surveys, and those made under his orders by junior officers of the department, are laid down from bases carefully measured on shore, where this has been possible, and are strictly trigonometrical; and though necessarily wanting that minute correctness aimed at in similar surveys on land, they possess, nevertheless, an accuracy fully sufficient for the scale on which the Charts are delineated. The base lines on shore are measured on the most favorable level spots that can be found, by running a ten-foot rod along a cord, stretched tight between the extreme points, and kept in position by stakes, of which the direction is verified by a telescope at one end. Second and third bases are measured for further assurance, and in correction of the first.

If there be no means of measuring a base on shore, as when the locality of rocks and sand-banks, out of sight of land, may have to be ascertained, recourse is had to the measurement of a base by sound, which in a long line of 5½ to 6 geometric miles is a process affording more practical accuracy than would be supposed. The vessels being anchored at this distance, and a calm period chosen, the distance is taken between the flash and report of a gun, and upon the assumption that sound travels at the rate of 1140 feet per second, while with repeated

*Note.*—The Andaman Islands were surveyed as far back as 1789, 90, and 1793, by Captain Blair.

experiments the time can be taken to a tenth of a second, the distance of the two vessels is obtained by this process to within at least 50 or 60 yards.

The angles subtended by the different points on shore, are taken always with the sextant, and the azimuth compass is only resorted to in order to lay down the true meridian. The practice of taking points by bearings of the compass, though common with many nautical surveyors of repute, is one that admits, comparatively with the sextant, of very little accuracy. The theodolite cannot be used on board ship.

Frequent observations for latitude and longitude, made both on shore and on ship-board, and as well from morning as from evening sights, afford further means of insuring accuracy ; and it has been stated, that upon the result of the survey made of the coast and archipelago of Mergui and Tenasserim, extending through a space of eight degrees of latitude, and of one or one and a half of longitude, and comprising upwards of 600 islands entered in the chart ; the difference in position of any two intermediate objects found trigonometrically, barely exceeded, when tested by careful observations for latitude, one quarter of a mile :—more than this cannot be desired for any purpose within the objects of a Marine Survey.

It has been usual for the Government, upon receiving each chart as it is completed, to strike off a few copies by lithography, and to send the originals to England, where they are engraved by the Court of Directors, and we presume, made accessible to the public. We have heard occasional complaint of difficulty in procuring copies, but whether that difficulty refers to their not being furnished from the Government offices in India, or to disappointment at not being able to procure them here to purchase, we confess that we do not thoroughly understand. The later Charts of Captain Ross, and in particular the very interesting survey of the Mergui archipelago and Tenasserim coast, are well deserving of the attention of the Geographical Society in England, from the additions they afford to the geographical information possessed of those countries ; and we hope to see them noticed with due acknowledgments by that Society. Did we possess the same facility of neat engraving, that publishers in England have at command, we should have thought it our duty to annex to this article, a sketch of the whole of this coast and of its islands, as now laid down, compared with the same as given in the latest previous Charts, in order that the extent of the improvement effected might be duly appreciated. The backwardness of India in this branch of art compels us to leave this to be done by others.

The progress of the maritime surveys on the western side of the peninsula of India, has not been less effectual in defining the outline and real bearing of the coasts, and the position of the islands, rocks, and sand-banks, between the Indus and the African shore, including the two inland seas of Persia and Arabia. We have not the means of stating the periods when each tract of this wide space was surveyed, or of giving the names of the officers employed upon the work; but we learn that a series of engraved charts, illustrative of a considerable part of the shore of Persia, has been lately received from the Court of Directors in England, and we know that a surveying establishment is maintained for those seas, quite independently of that under the Supreme Government at the head of which Capt. Ross is now placed.

That establishment, we may be assured, has not been idle, but it is the less necessary for us to enquire what may have been the result of its official labours, because we learn that a branch of the Royal Geographical Society has already been formed at Bombay, so that we may look forward to receive accurate reports of the progress making there in every branch of this science, either in separate publications for embodying the proceedings of the Branch Society, or in the communications and papers it will contribute to the pages of the parent Society in England.

The example of this diligence, ought not to be lost upon us ; and although the proceedings of our Asiatic Society, and several articles which this publication, or its predecessor, has been the means of laying before the world, sufficiently shew, that the interest and curiosity already directed to this field of science needs little further stimulus or excitement, yet we confess, that we think it might be adviseable for the Asiatic Society to form a separate committee of its members into a Geographical Class, whose labours should be specially directed into this channel, as is the case with the Physical Class already formed, and through whom correspondence might be opened with the Royal Geographical Society in England, and with the Branch Society more recently established at Bombay. This object is well worthy of the attention of those members of the Society who have devoted themselves to Geography, and who as navigators, travellers, and professional surveyors, may have already contributed, or may have the means of contributing to the stock of information already accumulated in this line. Their experience and talents cannot be more usefully employed than in comparing, combining, and publishing in a mature and digested form the materials which, if such a Committee of the Asiatic Society were in existence, would, there can be no doubt, be offered in abundance from many quarters.

## II.—*On the Mammalia of Nepal.*—*By* B. H. Hodgson, *Esq. C. S.*

[Read in the Physical Class, 8th February.]

The geographical distribution of animals is, I observe, daily attracting, more and more, the attention of the ablest Zoologists ; and reasonably, for this view of the subject has many relations of great interest and importance. On this account I am induced to offer to the Society, a summary enumeration of the Mammalia of Nepal. But as the territories comprehended within the dominions of the Gorkhâli dynasty, and now universally denominated Nepal, possess an extraordinary variety of temperature and physiognomy, it will be necessary to preface my account of the animals found within its limits, by a brief description of the climate and physical aspect of the materially different parts of these territories. These parts are three, the juxta-Indian, the Central, and the juxta-Himalayan. The first embraces the Taráï or marshes, the Bháwar or forest, and the little hills with their subject valleys up to the base of the mountains, properly so called.

The marshes and forest are on the level of the plains of Hindústan, and possess their climate, with some increase of heat from deficient ventilation, especially in the forest; and with an excess of moisture, derived from numberless petty streams oozing out of the hills, and dissipating their waters in the soil of the forest and Taráï, for want of force to cut channels for themselves into the rivers.

About $\frac{1}{20}$ of the Taráï is cultivated: the rest is overrun with topes gone to jungle, brush-wood, and giant-grass. Large tracts of the grass land of the Taráï are annually subdued by fire, and afterwards depastured by thousands of cows and buffaloes, but only for about two months ; after which the grass growing out of all compass, restores to these temporary pastures, the features of the surrounding wilderness.

The forest is entirely void of cultivation, and is a prodigious assemblage of noble trees woven together by immense creepers ; and incumbered, above, with air plants; below, with underwood and grass from 6 to 10 feet high.

The *third* portion of this tract, comprising the small hills with their subjacent valleys, up to the base of the great or true mountains, has the same character with the forest, (save where, here and there, one of the valleys has been cleared and worked,) and the elevation of this tract is too inconsiderable to make any difference in its temperature.

The malaria prevails equally and terribly throughout all three parts of this region, from the middle of March to the middle of October ; and whoever has traversed it must, I think, *feel* that the pestilence is

generated by the undue and almost exclusive prevalence of vegetable exhalations in the atmosphere. There is no free ventilation; and the forest and the lesser hills (where the malaria is worst) are absolute wildernesses of rank vegetation, of so extravagantly rife an increase that in Oriental phrase, you may almost *see and hear it grow!*

Yet, it is worthy of remark, that in this pest-house, from which all mankind flee, during 8 months of every 12, constantly reside and are bred* some of the mightiest quadrupeds in the world. The royal tiger, the panther, the leopard, the elephant, the *arna* or wild buffalo, the rhinoceros, and stags of the noblest growth, abound: and, what to our fancies is less singular, the same malarious region cherishes Boa constrictors of the largest size, and other huge creatures of their kind.

The like is notoriously the case elsewhere: yet still we may reasonably insist on the fact, and ask what is it in the constitution of these large quadrupeds, (I omit the serpents in the argument,) carnivorous and herbivorous, which enables them to breathe healthfully the air that is death to man. Take *tame* animals of their very kinds suddenly into this region between April and October, and, like man, almost, they will catch the malaria and die. On the other hand, there are particular tribes of men bred in these or similar places, (such as the Thârû of the spot and the Dhângar of South Behâr,) who can *live* there, at least, if not flourish. They die not; neither do they pine visibly;

* A friend, who is looking over my shoulder as I write, suggests to me, that Bishop Heber has observed in his Journal, that the malarious tract is entirely abandoned by wild animals, as well as by man and his flocks and herds, in the unhealthy season.

The Bishop probably was unaware that the malaria is not confined to the Taráï, properly so called, but rages thoughout the saul forest and the lesser hills, up to an elevation of some 3000 feet on the mountains: and that the wild animals, which are driven, by fire, out of the more open parts of the Taráï at the close of the cold weather, and cannot return till the rains have restored to them the shelter of a rank vegetation, retire during this interval to the covert of the forest and lesser hills.

If the elephants, rhinoceroses, wild buffaloes, and tigers, were to quit the malarious tract *altogether*, they must either ascend the huge mountains of the central region of Nepal, or, issue out into the plains of Hindústan: either of which suppositions is extravagant enough, one would think, to refute itself, were they not both of them, as they are unquestionably, refuted by notorious facts—such as the extraordinary depradations committed upon the crops of the Taráï by wild elephants and buffaloes issuing out of the forest at the height of the malarious season—the circumstance of European gentlemen seeking the tiger in his lair, on the confines of the forest, in March and April, at the hazard of their lives, because he is to be found *no where else*, &c. &c.

but they are poor specimens of humanity; whereas the great quadrupeds alluded to are the largest and most vigorous of their respective kinds.

These facts would seem to indicate, that the principle sought is that of inherited habits of body, or acclimatization, carried to such perfection by course of time, in respect to the great quadrupeds, as to have superseded their original and natural habits of body—carried to a much less perfect state in regard to the particular tribes of human beings in question. The elephant, tiger, &c. may well be supposed to have tenanted these recesses for countless ages—man has but recently attempted to divide the dominion with them. Yet, it must be confessed, that the notions broached carry the idea of physical adaptability to an extreme extent; besides contradicting the accepted opinion as to the superior capacity of man over the brutes in that respect. Let it be observed, that in these observations I wish merely to insist upon the singular fact, which I do not remember to have seen noted elsewhere, viz. that in the most noxious tracts of country, tracts in which man cannot live, some of the noblest quadrupeds abound and flourish—quadrupeds whose superior organization precludes the idea that the principle of life is differently modified in them and in man, and which consequently ought to be similarly affected with man by atmospherical causes. Why then, are they not so? Craving pardon for this digression, I now proceed briefly to characterise the region which I have denominated the central one.

This consists of a clusterous succession of mountains, varying in height from 3 to 10,000 feet, covered every where with a deep bed of mould, which feeds and sustains the most superb trees, and shrub vegetation, and grasses, in general, too rankly luxuriant to afford wholesome pasture.

The mountains are very precipitous, with extremely narrow intervals. There are no extensive high flats, such as we call table lands or plateaux, and only two low flats or valleys of any extent, which are those of Nepal proper and of Yûmila. The succession of the seasons is the same as in the first region, and in the plains of India; from which the central tract differs only in the material respect of temperature. Varying with the diversities of elevation, this region possesses a temperature from 10 to 20 degrees lower than that of Hindústan, and, with some allowance, its climate may be characterised as similar to that of the Mediterranean shores. It is as moist as the plains of North Behár, and, upon the whole, as salubrious as most countries in the world. Not a $\frac{1}{30}$th part of its surface, probably, is under the plough. For some unexplained reason (I myself suppose the rankness of the pas-

ture) neither the small nor large horned cattle flourish in it, in the domestic state: and the paucity of its wild mammalia would seem to indicate that animals of this class find its climate inimical to them even in the state of nature.

The third region of Nepal is the juxta-Himalayan, called by Buchanan the Alpine, and by the natives denominated the Kachár. From the crest or spine of the Hemáchal it extends, in breadth, about 10 horizontal miles. The mountains are of a like structure, and as splendidly wooded almost as those of the central region, but much higher, being, I should suppose, generally from 10 to 16,000 feet above the sea, up to the limit of habitability; where, of course, I stop. For half the year the summits of these mountains are buried under snow; and, *near* to the Æmadus, their sides and basal intervals also. The suite of the seasons is tropical, as before; and, occasionally, the heat is extreme. But the season of heat is short; and, upon the whole, the climate of this region more nearly resembles that of high than that of low latitudes. It has nothing tropical about it but the course of the seasons. Its grasses are short and wholesome: its underwood free from rankness; and hence probably its cows, sheep, and goats, are numerous, large, and fine; whereas, as already observed, they are few and poor in the proximate region, the succulent vegetation of which retains much of the tropical extravagance of growth. When the heats set in, in the central region, all the woollen-wearing inhabitants of the Kachár hie away to their own province; nor ever return till the approach of the cold weather. Ex uno disce omnes. It is the same with the birds as with the mammalia. There are peculiar ones to each of the three regions—a point which I insist on, because, those very persons who are so careful in mentioning the habitat of animals have described many procured from the kingdom of Nepal, without advertence to the particular part of that kingdom whence they were obtained.

I now proceed to my enumeration of the mammalia of Nepal, distinguishing such as belong to the lesser hills, forest, and Taráï, such as are found in the central region, and such as are peculiar to the Kachár. Let me begin by acknowledging that I am but an amateur zoologist, and have but recently turned my attention to the mammalia: but as I may be soon removed from Nepal, or may have my attention drawn off from Natural History to graver labours, I shall not let an idle conceit of accuracy prevent me from mentioning what has fallen under my observation, so far. My personal knowledge of these hills is chiefly confined to the central and northern

regions above defined; and of the mammalia of the lower or juxta-Indian region, I have probably less knowledge than was possessed by Abel, Duvaucel, and others, now alas! no more; but whose investigations have, no doubt, survived them. Without professing therefore to give a full or exact enumeration of the mammalia of Nepal, I proceed to notice the result of limited observation. Should I remain here, and have leisure, I can and will follow up the subject.

## Class MAMMALIA.

Sub-class Unguiculata. *Family* Bimana. *Genus Homo.*

The great indigenal mass of the population of Nepal belongs to the Kalmak division of the vast mongolian variety of the human race. But the dominant tribe of Khas are mongrels; derived, on the male side, from the Brahmans and Kshetriyas of India, on the female, from the Aborigines, and chiefly from the Magar and Járiah clans of these.

These observations apply to the northern and central divisions of the country. The southern or juxta-Indian division is peopled, so far as it is peopled at all, either by the Hindús and Músulmans of the plains, or, by a peculiar race demominated Thârû, of probably similar origin with the Bhíls, Coles, and other rude mountaineers of the great Indian continent. The Thârû, however, though their language and physiognomy prove them to be a distinct race from the Hindús, have probably been much mixed with the latter; and, at all events, are fairer, less ugly, and less barbarous, than the Indian mountaineers in question.

*Family* Quadrumana.

There are no monkeys in the northern and central* regions; and those of the southern region are identical, so far as I know, with the ordinary species of the plains, viz. the *langûr* and the *bândar*. There are no others that I am aware of.

I am not acquainted with any animal of the genus *Lemur* in Nepal; but the, for the most part, nocturnal habits of these animals tend to withdraw them from observation. It is probable, that the slow-paced *Loris*, at least, inhabits the lower hills; and possible, that species of other sub-genera are tenants of that immense solitude.

* Religion has introduced the Bândar into the central region, where it seems to flourish, half domesticated, in the neighbourhood of temples, in the populous valley of Nepal proper. My shooters were once alarmed in the Kachár by the apparition of a "wild man," possibly an ourang, but I doubt their accuracy. They mistook the creature for a câcodemon or rakshas, and fled from it instead of shooting it. It moved, they said, erectly: was covered with long dark hair, and had no tail.

*Family* Cheiroptera.

The genera *Galeopithecus* and *Phyllostoma* are, I believe, wanting. Of the four remaining genera of this family, viz. *Noctilio*, *Vespertilio*, *Pteropus*, *Rhinolphus*, there are abundance in the Taráï: but few in the central region, and fewer still in the northern. One species of *Rhinolphus* harbours in out-houses in the central regions, and occasionally enters dwelling houses at night when attracted by the lights. And one species of *Pteropus* appears in the autumn, and then only, to plunder the ripe pears in gardens. It is similar in characters with the great "fox bat" of the plains; but much smaller, and of a duller colour, or uniform dusky brown.

*Family* Plantigrada.

There are no hedgehogs in Nepal. Moles are found only in the Kachár. Musk shrews abound in the lower and central regions, wherever there are human habitations. The shrew of Nepal is a smaller variety of the familiar stinking creature called ordinarily the musk-rat in the plains. It is the *Sorex Indicus*. No such animal is known to the Kachár. Bears (*Ursidæ*) of different kinds abound in all parts of Nepal, and are very dangerous and troublesome:—in the Taráï, *Prochilus Labiatus* and *Helarctos Malayanus*;—in the central and northern regions, *Ursus Isabellinus* and *Ursus Tibetanus*. And here we may notice those interesting animals of newly proposed subgenera, which serve to connect the bears with the civets and weasels. *Ailurus Fulgens* and *Ictides Albifrons* belong to the Kachár, though they are occasionally found in the central region also. This latter division is the exclusive habitat of a new species of *Paradoxurus*, coloured, especially in youth, like the *Mustela Hardwickii*. It is not fœtid, and prefers, in confinement, vegetable to animal food. When very young its tail is not convolate.

*Family* Digitigrada.

Of the genus *Viverra*, or Civet, the *Zibet*, or Indian Civet, is common in the central region: but not known to the northern. It is probably found likewise in the lesser hills; but I am not aware of the fact. We have also, in the central region, a very small variety of the Indian ichneumon or *V. Mungos* of Gmelin.

The Taráï, Bháwar and lesser hills teem with all the known, large Indian species of *Felis*, such as the royal tiger, the panther, the leopard, the *cheeta* or hunting leopard, besides some described and undescribed species of smaller cats. To the central region the tiger is almost unknown, and so is the panther. But leopards abound in it; they however confine themselves almost entirely to the woods, sel-

dom approaching inhabited places, or doing greater mischief than the occasional destruction of a village dog. They are much less dreaded than the bears.

Some of the small cats of the central region are numerous and beautiful; such as the *Felis Nipalensis*. The Múrmi cat (mihi) is peculiar to this tract, in which and in the northern region also is found a species of wild cat belonging to the section of the lynxes, or medial cats, with shortish tails and pencilled ears. It answers precisely to *Felis Chaus* of Ruphel, but not to the booted lynx, which has usually been held to be the same animal. The domestic cat is as common in Nepal as elsewhere, and has no peculiarity worthy of note. Judging by its marks, I should conjecture that it is derived from the *Felis Nipalensis*; if so, it has lost by domestication the fine ground colour of that beautiful species. Strange as it may appear, it is unquestionably true that the royal tiger is found in the Kachár, close to the snows. But it must be remembered, that in that extraordinary region there are valleys of extreme depth and heat, as well as mountains of extreme height and coldness. Why this monster should avoid the central region, and yet seek the western one, may be probably explained by the paucity of ruminants in the former region, and by their comparative abundance in the latter: and it must be remembered, that there is free access from the Taráï and Bhâwar (the nursery of tigers) to the Kachár, by the means of the banks of the large rivers. The leopard is also found in the Kachár, and a variety of undescribed small cats. All the three regions of Nepal abound in weasels (*Mustelidæ*), many of which are unknown altogether to Natural History.

We have, in the central region, besides *Mustela Hardwickii*, another species nearly allied to it, but of a fuller habit, and larger: and yet another similarly allied, but very small and beautifully coloured. The two last are undescribed. In the lower hills is found a new species, with shorter tail than the above, and more closely resembling the vulgar weasel of England: having a white stripe down the vertex and a white band across the forehead; and one species in the Kachár, also new. The polecat likewise is an inhabitant of the central and northern regions,—rare in the former, and common in the latter.

Of the genus *Lutra*, we have seven species, all differing from either of the two species found ordinarily in the plains, as well as with one exception, from those described by authors. The exception alluded to is the common otter, (*L. vulgaris*,) of which the largest Nepalese species cannot be considered more than a variety. This animal

in Nepal reaches the length of five feet, inclusive of the tail ; and is upon the whole, the largest, though not the longest, species we have. It is peculiar to the lower region, where, also, three other species have their habitat. Two more belong to the central region : and one only to the Kachár. One species is yellowish white all over : the rest are brown, more or less dark ; some having the chin and throat, or whole inferior surface, paled nearly to white. They differ in extent from 5 feet to $1\frac{1}{2}$ foot ; and not much less considerably in bulk, for some of them exhibit an almost vermiform habit of body ; and others are as stoutly made as the badger.

*Genus Canis.*

The only domesticated species of dog found in any part of Nepal south of the Kachár is the common village dog, or *chien de rue* of the plains, usually known there by the name of the pariar, a prick-eared cur belonging to every body and nobody. The Parbattiahs however prize the creature, and render it useful in hunting deer and antelopes. It belongs to Cuvier's 2nd section.

The noble beast usually denominated the Nepal dog is found only in the Kachár, where alone in Nepal he can live. It was introduced into the Kachár from Tibet, in which region it is indigenous, and in various parts of which there are several varieties. That of Lassa is the finest, and is almost always black, with tan legs, and a false or 5th digit before and behind.

Landseer has excellently figured a male and female of this dog, which were taken from the residency and presented to the king of England. The *mustang* variety is rather smaller, of a bright red colour, with wall eyes ; and he wants the 5th digit behind. Even in the Kachár, this dog degenerates rapidly ; and he can no more bear the heats of the central region of Nepal than his country-fellows of the human race. This would seem to be the dog whose extraordinary powers, ages ago, surprised Alexander and his Grecians. It is found throughout Tibet. This dog is justly placed in Cuvier's 3rd section of the *caninæ ;* but he ought surely to be classed under the variety mastiff, not bull dog. His superior size, moderately truncated muzzle, long fur, sunken eye, perfectly pendant ears, and 5th claw on the hind foot (in the Lhassan animal at least) seem decisive of this point. The chief character of the skull consists in the great development of the longitudinal and transverse cristæ. There is a species of wild dog* peculiar to each of the three regions of Nepal. That of the lower region is the smallest and darkest : that of the central tract is of a

* *Canis primævus*, mihi. The *Búánsú* of the Nepalese.

deep ferrugineous red ; and that of the Kachár of a wolf-like reddish sandy yellow, as much larger than the wild dog of the central region, as that is larger than the species or variety belonging to the lesser hills and forest.

These dogs are very numerous, but so exceedingly shy of human habitations, that it is only by rusticating in the depths of the woods of Nepal that you have a chance of seeing or even hearing them. Through the kindness of the first minister of this state, I have obtained, alive, several individuals of them, especially of the variety peculiar to the central region, and have kept them in confinement for many months.

They are all alike distinguished by a double, thick coat; large, erect, wide, coarse, obtusely-pointed, ears ; feet with hairy soles ; a straight, very bushy tail, of medial length ; and jackal-like odour, form, proportions, and aspect. And, if I may trust 5 skulls, of mature or old individuals, now in my possession, their dental system contradistinguishes them from all their congeners : for they have only six molars on either side of either jaw. The swell of the parietal portion of the skull is very great ; and, as these primitive dogs have only a moderately elongated head, they must be arranged under Cuvier's second section of the *Caninæ*.

The jackal of the plains* is very abundant in the lower and central regions of Nepal, rare in the Kachár. In the Taráï, the small Indian insectivorous fox* is found ; but not in the forest of lower hills ; nor in the central mountains, nor in those of the northern region. Six years ago, I introduced it from below into the valley of Nepal ; and it seems to thrive well. The Kachár has a large peculiar species of fox, which I have not been so fortunate as to see. The wolf of the plains is unknown beyond the limits of the level country, nor is there any other species or variety peculiar to Nepal ; unless it be found in the Kachár : which I am not aware of. The like is true of the hyæna.

### *Family* Pedimana.

This family presents, as far as I know, a perfect blank.

### *Family* Rodentia.

The common species of the genus *Hystrix* is frequent in the central and lower regions ; unknown to the Kachár, I believe. In the Taráï,

* We want descriptions of both of these, which differ as varieties, from all those described.

the ordinary small species of hare* of the plains abounds: and thence extends into the central division, where, however, it is very scarce.

There is a larger species very nearly resembling the English, in the central and northern regions; but rare in both. The genera *Kangarus*, *Castor*, and *Cavia*, are unknown to us. In the southern region the common, little, striped, squirrel of the plains abounds. In the central region we have an animal of the same size and characters, but of an unstriped earthy-brown colour, tipped with golden yellow: and in both these tracts the beautiful flying squirrel is found—a large species, rich deep red-brown above, and golden yellow below; belonging to the sub-genus or subdivision *Sciuropterus* of the younger Cuvier. It is not known to the Kachár, but is most common in the central region.

Of the genus *Mus* we have none of the numerous sub-genera except *Mus* proper and *Arctomys;* the latter, confined to the Kachár. The rat of Nepal is a small variety of the common type (Norway rat), and is very numerous and troublesome. The *Mus giganteus*, or bandicoot of the plains, is unknown to it. House mice are rare, and no way peculiar: field mice, common. I have already noticed, in its proper place, the musk-rat, or, more properly, musk-shrew.

*Family* Edentata.

Genus *Manis*. The short-tailed species of *manis* is of frequent occurrence in the hills of the lower region, and in the mountains of the central tract. It is unknown, I believe, to the Kachár. The received opinion, that it has no external ears, is a mistake. I am not aware that any of the other genera of this family are found in any part of Nepal.

*Family* Tardigrada.

The solitary genus of this family† (*Bradypus*) is not, so far as I know, known to Nepal.

Sub-class UNGULATA. *Family* Pachydermata.

The elephant and rhinoceros abound in the forest and hills of the lower region of Nepal, where they breed, and have their fixed abode; and whence, in the season of the rains, they constantly issue

* Like the Indian fox and jackal, it still remains to be accurately described and distinguished.

† N. B. Arrangement is no part of my object; and, in want of books, I follow the tabular synopsis of the Mammalia given in the Gleanings in Science, No. 29. It is sufficiently near to the most accredited and notorious system to be generally intelligible, in the way in which it is used by me.

into the cultivated parts of the Taráï to feed upon the rice crops. Both these genera are entirely unknown to the central and northern regions. The elephant is that so well known as the Indian variety, and as such is contra-distinguished from the African variety. But it may be questioned, if there be not two distinct varieties or species in India alone, viz. the Ceylonese, and that of the saul forest. The former differs materially from the latter by having a smaller lighter head, which is carried more elevated, and by higher forequarters. It is also said to be larger, and of a more generous and bold temper. The difference of size, however, is certainly a mistake. I cannot speak to the point of temper. The rhinoceros is of the unicorn species. The two-horned is unknown.

The rhinoceros (as I had the good fortune, eight years ago, to have an opportunity of ascertaining in the menagerie of the Rajah of Nepal) goes with young from 17 to 18 months, and produces only one at a birth. When born, and for a month afterwards, the young has a pink suffusion over the dark colour proper to the mature hide. At birth, it walks pretty firmly, and measures three feet four inches long (exclusive of tail), and two feet high at the shoulder. At a month old, it is very active and vigorous, and measures 3 ft. 10 in. by 2 ft. 5 in. I have just seen and carefully examined this young animal. He is now eight years and a month old, but is certainly very far from being adult. His length (without the tail) is 9 ft. 3 in.—his height, at the shoulder, 4 ft. 10 in. utmost girth of the body 10 ft. 5 in. length of the head 2 ft. 4 in. and of the horn 5 inches.

The rhinoceros continues to suck its mother for nearly two years, and is believed to live at least 100 years; having been in one instance, taken mature and kept at Kathmandu 35 years, without exhibiting any symptoms of approaching decline. If reared in confinement, or taken young, the rhinoceros is perfectly tractable, and may be driven out to graze, through the streets of a crowded city, by a single man without even a halter to restrain it.

Of the remaining genera of the *Pachydermata*, we have only the wild hog, which is common to all the three regions of Nepal, and is plentiful in all. It resembles that variety found in the plains of India, which is or ought to be distinguished by small tushes and a nearly horizontal back, the other Indian variety being conspicuous for the elevation and weight of its forequarters, and the superior development of its canine teeth or tusks.

*Family* Ruminantia.

The great forest of Nepal is the nursing mother of numberless animals of the genus *Cervus*, which, in the rainy and cold months, when cover abounds, thence issue into the Taráï; and in the hot months, when fire is effectually employed to clear the Taráï, and forest too in a less degree, of grass and underwood, retreat into the recesses of the lower hills.

Besides the Chittra, the Lagna or Páda, and the Súgoriah of the plains of Hindústan, (the spotted *Axis*, the spotted and the brown Porcine *Axis*, respectively,) to the lower region of Nepal belong, the Bárah Sinha, a splendid variety of the common stag or *Cervus Elephus;* three species of the *Rusa* group of Major Smith, denominated collectively Jarâï by the Nepalese, and contradistinguished by the epithets Phûsro, Râto, and Kâlo, or hoary, red, and black; of which the first is the *Cervus Hippelaphus* of Cuvier; the second, possibly, Major Smith's *C. Equinus;* and the last, undescribed, the Bahraiya, a new osculant species, serving with *C. Wallichii*, to connect the Elaphine and Rusan groups of Smith; and, lastly, a new species of Muntjac described by me under the local name of Ratwa.

There is no deer proper to the central region but the Ratwa, which, though it occur in the hills of the southern division, and in the lowest valleys of the Kachár, is the more peculiar inhabitant of the middle tract. I can make nothing of Sir W. Ouseley's musk deer of Nepal, referred by Smith to the Muntjacs, and named *C. Moschatus*.

The Râto Jarâï is sometimes found in the mountains; but it, and the other two species of Jarâï, belong decidedly to the lower region.

In the Kachár there is no species of *Cervus;* the Nepal deer or *C. Wallichii* being, I am pretty sure, trans-Himalayan; and the Râtwa being, as already hinted, a vagrant there.

Of Antelopes, the Ghoral (*A. Ghoral*, Hardwicke) belongs exclusively to the northern and central divisions; the Thár (*A. Thár*, mihi) properly to the central, though he occurs also in the northern and southern regions; and the four-horned and black antelopes, (*A. Chikara* and *A. Cervicapra*,) exclusively to the lower region. The former keeps to the open plains of the Taraï; the latter, to the cover of the saul forest. And there are no more antelopes in Nepal; for the Chírú (*A. Hodgsonii*, Abel,) never passes the Himalaya, nor even approaches that stupendous chain of mountains; it being confined to the open plains of north-eastern Tibet. The Thár, much more

properly than the Ghoral*, belongs to Major Smith's *Nœmorhœdine* group, and bears an extreme resemblance to the Cambing Ootan of Sumatra. The females of the Thár species, however, have four teats, and carry horns. Wherefore, those indicative characters of the group, set down with a note of interrogation by its author (viz. females hornless and with two mammæ), would seem to be incorrect. In the Thár the bony core of the horns is cellular, and connected with the frontal sinuses; and the horns arise very decidedly behind the orbits; material deviations from *Antilope*, and approximations to *Capra*, agreeing with the generally Caprine character of the external attributes of this species, which is indeed linked to the antelopine genus only by its horns and suborbital sinuses. In respect to that beautiful little animal of the *Tetracerine* group, called Chouka in Nepal, Chikara in the plains, I am enabled, by means of a beautiful specimen, to say that the distinction of species attempted to be established upon the Duvaucellian and Hardwickian specimens and drawings cannot be maintained.

To the northern division are exclusively confined the wild goats and wild sheep of Nepal; of the former of which genera there is one species only, viz. the Jhâral (*Capra Jharal*, mihi), and of the latter, two species, viz. the Bharal and the Nayaur, or, *Ovis Argali*, Pallas, and *Ovis Nayaur*, mihi. The latter, however, is probably only a variety of the former. The common domestic goat of the Kachár, called by the Parbattiahs, Sinál, is a tall largish species, with ordinary horns; long, flowing, straight hair, drooping, longish ears, and semi-erect, short tail. A small variety of the Chángra, or shawl goat, is not uncommon in the same quarter. Neither of these can endure the heat of the central, and far less of the southern region, except in the cold season.

These latter regions have no domestic breed of goats in any respect peculiar to them. The species found in them is the common little goat of the lower provinces of the Bengal presidency. It is rare and thrives not; though it does better than the goat of the upper provinces; which can scarcely be bred as a luxury or curiosity by the rich.

The domesticated sheep of the Kachár or Baruál, is a stout, middle-sized, short and narrow-tailed species, with chaffron extremely arched, massive horns, retaining the primitive character of the wild

* M. F. Cuvier is mistaken in supposing the Ghoral to have suborbital sinuses. It has none. The ears are striated.

race, and very short, semi-truncated ears, depressed by the incumbency of the horns.

The rams are celebrated for their courage and pugnacity. The wool is good, but far inferior to that of the Hûniah or Bhoteah sheep, which, though naturalized in the Kachár, is of trans-Himálayan origin, and still scarce as compared with the Baruál, immense flocks of which native species are reared in the Kachár.

The Hûniah is a large, tall breed, with slender, compressed, spirally-twisted, horns, and short narrow tail. The colour is almost invariably white. Individuals of this species are apt to have 3, 4, and even 5 horns. The Hûniah cannot bear the heats of Nepal, south of the northern division, and will doubtless flourish in England, where the experiment is making of naturalizing it. Its wool is superb*. The tame sheep of the central region, or Kágo, as it is named by the Parbattiahs, is a small breed, bearing all the characters of the Barual; from which variety it evidently sprung at no very remote period : horns and tail, as in the Baruál : ears longer, pointed, directed forwards and downwards : chaffron less arched : fleece finer, shorter, spirally curled, almost always white.

The lower hills have no peculiar breed of sheep. Goats and sheep, rare in the central, are almost unknown in the southern hills: but both, and especially the latter, are very numerous in the northern division.

The domesticated cows of the Kachár are large and variously colored like those of England : the cows of the central region small, and black or red, like those of the Highlands of Scotland. But in the second, the hump is conspicuous ; and not absent in the first. The *Bos grunniens* or Yak of Tibet likewise flourishes in the Kachár : but not south of it. It is a mere foolish error to suppose the milk of the Yak not good.

There are no wild animals of the Bovine kind in any part of Nepal, save the southern, where, as far as I know, the wild buffalo alone represents the genus—the Gayál or wild Bull of the Indian mountains being unknown to us.

### *Family* Solipeda.

Wild animals of this family are utterly unknown to Nepal ; and in the domesticated state we have only some small varieties of the Tibetan pony, called here Tánghan : and though coarser and heavier, somewhat

* N. B. Should this paper meet the eye of any wealthy and spirited individual in England, who may be disposed to forward the experiment in question, I beg to say, I shall be happy to assist him. Let him refer to Messrs. Mackintosh and Co. Calcutta.

resembling in size and character the Shetland pony. This breed is found from the confines of China to the Bilú Tag: on the western side of which range of mountains it increases in size, and becomes the Chougosha horse of the Turks. The Tánghan is bred exclusively in the Kachár division of Nepal: and but very rarely.

We have no tame asses or mules; man being, in Nepal, the sole "beast of burthen;" by reason of the steepness of the mountains, and the want of made roads.

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## III.—*Memoir of Giuseppe d'Amato.*

[Extract of a private letter from Major H. Burney, Resident at the Burmese Court, dated Ava, 9th April, 1832.]

I grieve to tell you, that the good Italian priest died last week at Moun-lha, one of the small Catholic villages up the Moo river, near Dibayen, and about 30 miles to the north-west of this city. It is a pity that some account of the life of this humble missionary cannot be communicated to the civilized world. He was a native of Naples, and his name was Giuseppe d'Amato, although he was better known to his Catholic flock, who understand only Burmese and the native dialect of Portugueze, by the style and title of Padre Don José. He and another priest, Luizi de Grondona, or as he was styled Don Louis, were deputed from Rome by the Society *De Propagandâ Fide*, at the peace of Versailles in 1783. They went to England for a passage to this country, where they arrived sometime in 1784. Soon after, the wars of the French revolution put a stop to all communication between them and Europe, and for upwards of 30 years they received no assistance whatever from their Parent Society, and were obliged to trust to their own exertions and to the charity of their followers, who are most of them in a state of poverty themselves, for the means of subsistence. They were both skilled in medicine and surgery, but particularly Don Louis, of whom very honorable mention is made by Colonel Symes in his second mission in 1803, and by Captain Canning, on several occasions. Don Louis died in this city about nine years ago.

Don José usually resided in the midst of his flock, which occupy five small villages, distant from each other from four to 10 miles, and situate in the district of Dibayen to the north-west of this city. The names of these villages and number of houses in each are stated to be as follows:

| | |
|---|---|
| Moun-lha, | 25 houses. |
| Khyoung-Yo, | 15 |
| Khyan-ta-roowa, | 100 |
| Khyoung-oo, | 15 |
| Nga-bek, | 20 |
| Total | 175 houses, |

which are said to contain a population of about 960 souls. Most of them at one time professed the Catholic religion, but of late years many have apostatised, as D'Amato complained to me.

Besides the above-mentioned villages, there is a small one containing about 40 or 50 souls, called Mengalágoure, situate close to the western walls of this city, near the British residency. To this village, in the centre of which are a Chapel and Parsonage, built of bambús and leaves, Don José paid an annual visit about Christmas, and it was here that I first saw him in December, 1830.

He was then about 73 years of age, and I was particularly struck at observing how lively all his recollections of his native land still were. He described Naples and a celebrated piece of sculpture there, with a degree of gesture and youthful animation that quite surprised me. "Dear Italy," was always a favorite theme with him; when he first heard Mrs. ——— play on the piano forte, he burst into tears, and he wept like a child for half an hour, begging all the time that the music should not cease.

He shunned the court, and never went near any of the great men here, if he could avoid it. He lived always among his flock like one of themselves, and was venerated by them in no common degree. His dress consisted of a pair of trowsers with a black cotton gown, and Burmese sandals on his feet. He said he found stockings very uncomfortable, and could not wear them even during the cold season. His amusements consisted in drawing and painting, gardening, and when he was in the country, in driving about in a Burmese cart drawn by oxen. He said, that he had never been sick for even a day until the year I first saw him, when his constitution was evidently breaking. But even then, he walked about a good deal, and made no use of spectacles.

The district of Dibayen, in which he lived, was at one time much infested with banditti, and Bundoolah has the credit of having put them down, and settled that part of the country just before the late war. D'Amato's knowledge of medicine enabled him to do a great deal of good among the population in his district; and although the

village in which he resided was repeatedly plundered, he was himself never infested but on one occasion, by a robber who did not know him, but who was soon checked by the rest of the gang. When Dr. Richardson went from hence to the frontiers of Manipúr last year, he heard every where on his route the most pleasing accounts of the charity and active benevolence of old D'Amato. The Burmese of all classes respected him greatly, and when he was seized and put in irons by an officious officer, at the time the English army was advancing from Pagan, the moment the king heard of the circumstance, he ordered D'Amato to be released, observing, "He is like a *god;* why should we molest him?"

He was intimately acquainted with both the Pali and Burmese languages, and was allowed to be deeply read in Burmese scriptures, knowing more about them, a *Woongyee* once told me, than some of the best informed among themselves. He gave me some curious drawings and explanations in Burmese of the Búdhist cosmogony, geography, &c. I hope to send them to you some day with my translations.

D'Amato was a respectable painter, and as he knew something of natural history, he had made a collection of drawings of about 300 non-descript plants and flowers, and about 200 animals, writing down at the same time all he could learn as to the *habitat*, properties, &c. of each. He had bound the whole in four folio volumes, two containing the drawings and two the explanations. These volumes had occupied his leisure hours for nearly forty years; but when the late war broke out in 1824, he was apprehensive of some accident to himself, and he delivered these books to the charge of one of his flock residing at the village of Men-ge-la-goun. After the last Burmese army was defeated at Pagan, the king ordered some additional defences to be constructed around this city, and all the approaches to it were cleared; Men-ge-la-goun was burnt and plundered: a private soldier, it was said, got possession of D'Amato's books, and the prettily coloured drawings in them induced him to carry them to the Queen's brother, Mengagyee, who gave the soldier a *patsho* or cloth, and kept the books. Report added, the Mengagyee had cut out most of the pictures, and stuck them up in different parts of his house.

The moment I learnt all this from D'Amato, I applied to the king himself, and to all the ministers, urging them, in the strongest terms, to have these books restored to their poor owner. I told them plainly, that as these books contained no political information, but related entirely to objects of general science, the king and the whole of his

court would be considered as a set of the greatest barbarians by every civilized nation, if works of such a description, belonging to a priest, were not forthcoming. The king repeatedly ordered every search to be made, and the ministers, to do them justice, exerted themselves to recover the books, but without success. Mengagyee denied all knowledge of them, and had me taken into the inner apartments of his house to prove to me that they contained no such drawings as those belonging to D'Amato. I believe the king and his ministers were sincere in their desire of recovering the books; but I am sorry to say, that I have never been able to discover what has really become of them, although, supposing that they might have fallen into the hands of some private individual, I offered a very large pecuniary reward to any one who would produce them. It was pleasing to see, when I gave up the inquiry, with what pious aud Christian-like resignation poor D'Amato submitted to this loss of the fruits of so many years' labour.

D'Amato is to be buried in great state, and his body is preserved in honey, until the whole of the Christians in this quarter can assemble, and pay the last honors to the remains of their venerated pastor.

I may mention here, that the inhabitants of the five Catholic villages in the district of Dibayen are the descendants of certain French and other prisoners, whom Alompra took at Syriam, in 1756, and brought up and settled here. Many of these Christians still show their descent in the light colour of their hair and eyes; but besides the descendants of the Syriam captives, it is reported, that in those villages, and at another village near Mouttshobo, there are many persons with light-coloured hair and eyes, who have a tradition, that their fathers were shipwrecked somewhere on the coast of Arracan, and brought up and detained in this part of the country, so far back as in the reign of some *fortieth* king from the present monarch. Possibly some of them may be descended from those English establishments which Dalrymple relates as having existed at Ava and to the northward, on the borders of China, about the beginning of the 17th century.

In the month of June, last year, D'Amato was joined by two young colleagues from Rome. They came to Rangoon viâ Egypt and the Red Sea, accompanied by a *Bishop* of *Ava* by name Frederico Cao, and another priest, who are now residing at Moulmein. The two priests who have come up here, Antonio Ricca and Domingo Tarali, are natives of Italy, and appear to be intelligent, amiable young men. The Pope must have strengthened his Ecclesiastical

Establishment in this kingdom, with a view, I presume, of making converts. Hitherto, the Catholic clergy here appear to have confined their labours to their own flock, without any desire of increasing it. Besides the number of Catholics in Dibayen and here, there are about 260 souls at Rangoon under a Padré Don Ignatio; and many of these are wealthy enough to build themselves a good brick Chapel, which they have lately done. The Catholics near Ava live and dress like Burmese, from whom, I am sorry to say, they cannot be distinguished by any superiority in moral or intellectual qualities. Pére Domingo is now residing at Khyan-ta-roowa, and Pére Tarali at Ngabek.

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## IV.—*Oriental Accounts of the Precious Minerals.*

[Translated by Raja Kalíkishen; with remarks, by James Prinsep, F. R. S. &c.]

I have been favored by Raja Kalíkishen, with some interesting extracts from oriental works, respecting the precious minerals, which I have embodied in the present notice, with such modifications, as appeared necessary to suit the mineralogical reader, and with the addition of a few remarks in elucidation of the subject arising from a reference to the original works obligingly lent to me by the Raja, as well as from an examination of the rough minerals themselves, where I could procure them from the native jewellers. I trust that the Raja will continue his translations from similar works, both Persian and Indian, as nothing can conduce more to a right knowledge of that, at present, obscure subject, oriental mineralogy. A great variety of mineral substances are sold in the bazars of India, and included in its materia medica, of the proper classification of which we are as yet altogether ignorant.

The information contained in the present notices is extracted from three books, of different ages: 1, the *Ajáib-ul-makhlukát o Gharáib-ul-moujudát*, an ancient Persian work on natural history, written by *Zakarya*, a native of *Kufa*, date unknown; 2, the *Aqul-i-ashreh*, a work on science, by Mahomed of Berar, An. Hej. 1084, (A. D. 1673;) and 3, the *Jawáhir-námeh*, a modern anonymous compilation, containing much useful matter in a condensed form: it was probably written at one of the native courts, either Delhi or Hydrabad, since it mentions the opening of recent mines in India.

The two former volumes comprise sketches of all the different sciences known to the ancients. The third, as its name denotes, particularly treats of mineralogy. The Raja has not attempted to give a verbal

translation of either, and I shall follow his example in merely gleaning the facts which appear curious, or peculiar to oriental ideas.

### The Diamond.

A. *almás*; G. αδαμας; S. *híraka*; H. *híra*.

In Arabic and Persian works of natural history, Aristotle is generally quoted as the chief authority whence information is drawn, and the most vague and fabulous tales of the origin and qualities of natural substances, are laid to his account; many no doubt with justice, but more without any authority whatever. Thus, of the diamond, some authors assert, that when Alexander visited the mountain *Zulmát*, (others call it *Sarandíp*,) where the inaccessible valley of diamonds is situated, he directed pieces of flesh to be thrown in as the only means of procuring the gem:—vultures picked up these with the precious stones adhering to them, and dropped them in their flight, on various parts of the earth, where alone they are now discovered! It must be confessed at least that we have no theory of the *origin* of the diamond to offer in lieu of this oriental hypothesis.

The *Aqul-i-ashreh* does mention in general terms, that there are mines in the south-east of *Hindust'han*. The *Jawáhir-námeh* is more explicit, and notices a new mine opened in southern India, at *Kompila*, between *Mahali* and *Bijapúr*, near *Masulipatam*.

The *Jawáhir-námeh* describes the mode of digging for the ore, and washing the sand or gravel. The similarity between the diamond and rock crystal, both met with in the same matrix, has given to the latter the appellation of *kacha*, or *unripe*, and to the real gem, that of *pakka*, or *ripe*, diamond.

The diamond is supposed by some to be a preservative from lightning, and to cause the teeth to fall out when put in the mouth, but this is objected to by one author, on the ground, that diamond powder has been used for tooth-powder with no bad effects.

The *triangular* (tetrahedral) form of the pulverized fragments is noticed: also the natural cleavage, which is adroitly taken advantage of by the native *hakáks*, in forming table diamonds, by striking the stone between two sharp-edged tools.

Some knowledge of the combustible nature of the diamond might almost be inferred from a passage in the *Ajaib-ul-makhlukát*. "If it be exposed to the strong heat of a wind furnace, it will be melted*,"

* The original passage is as follows, and I am not sure that I have given the correct translation:—

اگرالماس را دردم نفیس اندازي و برانش غرغه کنی گداخته شود وان نافع
ازبراي دفع منغص وفساد معدم

probably alluding to the rounding of its edges by slow combustion. *Zakarya* also says, that if mixed (fused ?) with pure sal ammoniac, the diamond will dissolve, but not with lead, *sarb;* probably the oxide of lead is intended.

"The great mart for diamonds formerly seems to have been at *Kalbargah*, to the west of Hyderabad, where a clear rough diamond of two carats would sell for 7 *filori*, (a gold coin; the etymology of the word is not evident, perhaps it may be a corruption of florin.) When dressed, the same stone would fetch 15 *filori*. The European lapidaries are stated to be the only workmen who can by cutting and polishing fully develope the brilliancy of the diamond."

### Rhombohedral Corundum or Sapphire.

A. *yaqút;* G. ακανσα? S. *manikya;* H. *manik.*

Under the name of *yaqút* are comprised all those stones of the sapphire and ruby species, which are distinguished (or rather connected, as being chemically one) by the epithet *oriental*, in English books of mineralogy, and are now classed together under the general head of corundum, because they are composed of the same earth, alumina, as the corundum or *kúrún* of the Indians. The natives, like our own mineralogists, distinguish four principal species of *yaqút;* red, blue, yellow, and white, or colorless.

The first, or Oriental Ruby, A. *yaqút-ahmar*, H. *manik ?* exhibits seven varieties of colour, viz. *mihrmátí*, striped; *arghwání*, hyacinth; *rumání*, bright-red, or pomegranate; *rúí*, brass-colored; *khamrí*, red-wine-colored, the Amethyst, H. *nagína; lahmí*, flesh-colored; and *khylí*, or asafœtida-colored.

"Not to be deceived in rubies, is a work of difficulty, because there are spurious ones of polished crystal, which much resemble the true gem; these are called *áyn-ul-rajún:* but a skilful lapidary will easily recognize them. When placed in the fire, a true ruby becomes invisible, but when immersed in water, it appears to glow with heat: it also shines like a coal in the dark."

The second is the Oriental Sapphire, A. *yakut-arzaq* or *qabúd, safír;* G. σαπφειρος*; H. *nilam.*

Of this, there are enumerated five varieties, viz.: *taüsí*, peacock-tail

* It is doubted whether the σαπφειρος of the ancients was not rather *lapis lazuli* than the gem now called sapphire:—it was called χρυσοπαρος from the yellow spangles in it. (*Theophrastus.*) Pliny includes it among the *cyani*, a general name for all blue stones: he says, "Causam nominis afferunt quod usque ad *vini colorem* accedens priusquam eum degustet, in violam desinat." If the word is derived from the name of a colour, it may be from *asfar;* but that would signify *yellow* rather than *purple* wine.

blue; *asmâní*, azure; *níli*, indigo; *chakli*, grey or collyrium; and *sabzí*, greenish.

The third or ORIENTAL TOPAZ, A. *yaqút-asfar* or *zard*, H. *pokhraj*, has four tints, viz. *narinji*, orange; *káhi*, straw; *shamâí*, flame or lamp; and *turanji*, citron-colored. This variety is said to stand the fire better than the others.

If the *yaqút akhzar*, or ORIENTAL EMERALD, be esteemed the fourth variety, then there is a fifth, "of more variegated tints but of less value," comprising probably such as are not transparent, common corundum, adamantine spar, *salam* [*silan*, or *ceylon*] *stone?* &c.

Gladwin translates *yaqút* and *yaqút surkh* as "topazes," in his English version of the *Ayeen Akbery;* the *yaqút rumani* (written *rahmâní* in the MS. belonging to the College of Fort William) and the *yaqút kabúd* he calls the "sapphire:" and on one occasion he renders the *yaqút surkh*, "amethysts:" showing the confusion which prevails on the subject of these gems. That different species of the corundum, however, were intended by all, is evident from a table of specific gravities quoted by Abu Fazl from a work of *Abu Rihan-al-Birouni*, which closely agrees with modern results, and proves that the term *lâl* (hereafter to be noticed) is confined to the Balas or spinelle ruby: the table reduced to decimal expressions is as follows:

| *Name of Jewel.* | *Spec. Grav. by Abu Rihan.* | | *Spec. Grav. by European tables.* |
|---|---|---|---|
| *Yaqút rumani*, ..... | 3.98 | oriental sapphire,.... | 3.97 Mohs. |
| *Yaqút súrkh*,..... .... | 3.75 | ruby, topaz, &c..... | 3.90 do. |
| *Lâl*, ..... | 3.52 | spinelle ruby, ..... | 3.52 do. |
| *Zamarûd*,..... | 2.75 | rhombohedral emerald, | 2.73 do. |
| *Bilor*,..... | 2.50 | rock crystal, ..... | 2.58 do. |

The *Jawáhir-nameh* includes among the varieties of *yaqút*, the *âyn-ul-hireh* (cat's eye) and the *turmali*, from which latter word may, perhaps, be derived our *tourmaline*, though applied by us to a different mineral.

The *âyn-ul-hireh* (H. *lahsúnia*) is evidently that variety of the sapphire which mineralogists designate *chatoyant*, or *opalescent sapphire*, and which, when cut en cabochon, shews a silvery star of six rays, and is then termed ASTERIA. This must be distinguished from the common cat's-eye, a chatoyant variety of quartz with which it has probably been confounded by the oriental jewellers. Pliny also adverts to the two minerals: of the first he says, "proxima candicantium est *asteria:* nata est in Karmania, &c." and he distinguishes it from an inferior sort of *astrios*, resembling common crystal, which comes also from

India and "Pallenes littoribus." There were several inferior sorts : 1, those called *ceraunia* in the east; 2, the *astroites* much praised by Zoroaster; 3, the *astrobolos* of Sadines, resembling the eye of a fish, &c.: all of these appear to have been varieties of the quartz cat's-eye. "The jewellers appraise the value of the *âyn-ul-hireh* according to the number or perfection of the threads *(zanâr)* visible in it, which should give the stone, when turned about, the appearance of a drop of floating water." This description accords with the quartz cat's-eye rather than with the asteria; but there is some difficulty in reconciling the uncertainties regarding this mineral, and I have not been able to obtain the actual name of the *asteria* for the want of a specimen of the stone.

The *âyn-ul-hireh* probably, however, comprises both of the above minerals; in the same manner as the *turmali*, next to be mentioned of the varieties of *yaqút*, apparently embraces both the zircon and tourmaline families.

"To the *turmali*, as being of a greenish yellow tinge, people frequently give the name of *zabarjad*, or beryl? It is found in small rounded pebbles in the same rock or matrix as the other Ceylon stones."

An uncut specimen of *turmali* and several polished stones, obtained from a native jeweller in Calcutta for examination, proved to be the "jargoon of Ceylon," or precious zircon. It had a specific gravity 4.56; hardness 7.0; fracture vitreous; colour greenish, some quite transparent and clear; form rounded, amorphous: inalterable before the blowpipe per se. The colorless *turmalí* is cut and sold as a false diamond, in the bazars of India. Davy says, that "the yellow varieties of the zircon are sold by the inhabitants of Ceylon as a peculiar kind of topaz; the green as *tourmalines**, the hyacinth red, as inferior rubies, and the very light grey, as imperfect diamonds; the natives being altogether ignorant of the true nature of this mineral. It is most abundant in the district of Matura, whence it has its common name in Ceylon of *Matura diamond*†."

Of the localities of the *yaqút*, it is only stated in two of the works before us, that the gem comes from the hottest part of the globe, "from the south near the equator." In the *Jawâhir-nameh*, however, the large island of Ceylon is said to be its only habitat, where it is generated in caverns from the suppuration and solidification of the essence of water! "The natives dig wells in these places, and wash the *sand*

* In Rees' Encyc. the Singalese name for tourmaline is stated to be *tournamal*.

† In speaking of the hyacinth (which among us is a variety of the zircon) Pliny says, "Hunc colorem Indi *sacon* vocant, et talem gemmam *sacodion*."

extracted from below, for the various minerals which are disseminated in it."

The medical properties of this gem are remarkable: "it purifies the blood, strengthens, quenches thirst; it dispels melancholy reflections; and, as a talisman, averts dangers, insures honor and competence."

In hardness it only yields to the diamond: it is unaltered by the fire, the red and yellow varieties, if any thing, improving in color therefrom. The blue, or sapphire, when pure, is of equal value with the diamond. The Arabs are fond of engraving their names upon it.

Besides the *Sílaní* or Ceylon *yaqút*, there is stated in the *Jawáhir-nameh* to be "another ruby, now very much in vogue, which is extracted from a mine in Bengal, near *Tahat-ul-Suráa*, in the vicinity of which is an island, called *Rakhang*, nigh to which is a stream, where also the ruby is procured." *Tahat-ul-suráa* may mean a deep mine; Rakhang is the Arracan of Europeans. "It is greatly valued in *Hindústhan*. Jewellers assert, that its nature is soft, and that fire will dissolve it, but from its appearance or touch no idea can be formed of these defects." This account may refer to the spinelle ruby about to be described, or to a species of garnet.

### Dodecahedral Corundum or Spinelle Ruby.

P. *lál;* H. *manik ?* or *lál.*

Concerning this gem there is considerable incertitude among oriental authors, which an acquaintance with mineralogy alone can dissipate. Jewellers of the present day apply the term *lál* to all rubies of a fine red color. It is evident however from the books before us, that the *lál* is quite distinct from the *yaqút*, and that it properly designates what we term the *spinelle* ruby*. The *lál rumani*, scarlet or pomegranate-coloured ruby, is probably the true spinelle; while the *lál Badakshání*, or ruby of Badakshan, of a rose color, is what Europeans call the Balas ruby; indeed it appears possible that Balas may be a corruption of the latter name; for, the French Encyclopedia says, the name is derived from the kingdom whence the rubies come, supposed to be situated, vaguely, somewhere between Pegu and Bengal. *Balkh*, the capital of Badakshan, might have been written *Balach* in French, and afterwards softened to *Balas* by the same process which has converted the *Khan* into the *Cham* of Tartary.

* The etymology of the word *spinelle* is obscure—Tavernier describes among Indian varieties of the ruby, the "*espinels* or *mothers of rubies*."

The Persian authors are particular in their description of the locality and origin of this stone. "The mine of this gem was not discovered until after a sudden shock of an earthquake, in *Badakshan**, had rent asunder a mountain in that country, which exhibited to the astonished spectators a number of sparkling pink gems of the size of eggs. The women of the neighbourhood thought them to possess a tingent quality, but finding they yielded no coloring matter, they threw them away. Some jewellers, discovering their worth, delivered them to the lapidaries to be worked up, but owing to their softness the workmen could not at first polish them, until they found out the method of doing so with *mark-i-shísá*, marcasite or iron pyrites. This gem was at first esteemed more than the *yaqút*, but as its color and hardness were found to be inferior to the latter, it became less prized."

There are many varieties of color: red, yellow, and greenish, but the *piazi*, reddish yellow or onion-colored, (the *rubicelle ?)* and the *mina*, violet-colored, (the *almandine* ruby ?) are held in the highest estimation; of the red there are given eight tints, wine color, date color, Brazil wood color, &c. which it is needless to enumerate. The author of the *Jawáhir-nameh* says: "as the *lál* ruby did not exist in the time of *Jemshíd*, no mention of it is to be found in ancient works; modern physicians ascribe to it the same medicinal qualities as the *yaqút* possesses."

In a manuscript history of Cashmír and the countries adjacent, by Abdúl Qádir Khan, Benares, 1830, is the following description of the manner of extracting rubies from the *Badakshan* mines: it professes to be taken from an oral account by Mirza Nazar Báki Bég Khán, a native of *Badakshán*, settled at Benares.

Having collected a party of miners, a spot is pointed out by experienced workmen, where an adit is commenced. The aperture is cut in the rock large enough to admit a man upright: the passage is lighted at intervals by cotton *masháls* placed in niches; as they proceed with the excavation, the rock is examined until a vein of reddish appearance is discovered, which is recognized as the matrix of the precious gem. This red colored rock or vein is called *rag-i-lál*, or, the vein of rubies; the miners set to work upon this with much art, following all its ramifications through the parent rock.

* The *Manaif-ul-ahjár* dates this occurrence "350 years ago," but the date of the work is not given: the *lál* is not mentioned by *Zakarya*. Since the above was written, Mr. H. H. Wilson has favored me with a sight of another work on jewels, entitled *Khawás-ul-hejár*, translated by himself, in which the *lál* is treated of under the name of *balaksh* (*Balakshan* being synonymous with *Badakshan*). This leaves no doubt as to the origin of the word Balas. *Banaksh* is also described as a variety of inferior quality and no value. The word is not used by other authorities.

The first rubies that present themselves are small, and of bad colour: these the miners called *piadehs* (foot soldiers): further on some larger and of better colour are found, which are called *sawars* (horse soldiers); the next, as they still progress in improvement, are called *amirs*, *bakshis*, and *vazirs*, until at last they come to the *king jewel*, after finding which, they give up working the vein: and this is always polished and presented to the king. The author proceeds to describe the finest ruby of this kind that had ever fallen under his observation. It belonged to the Oude family, and was carried off by Vizir Ali; he was afterwards employed in recovering it from the latter: it was of the size of a pigeon's egg, and the color very brilliant; weight, about two tolas; there was a flaw in it, and to hide it, the name of *Julál-ud-dín* was engraved over the part; hence the jewel was called the *lál-i-jaláli*. A similar ruby to this, but considerably larger, is in the possession of *Runjit Sinh*, and has the names of five emperors engraved upon it.

The bright-red spinelle ruby, *lál ramáni*, is called by modern jewellers *yaqút narm*, or simply, in Hindústani, *narmeh;* also *lálrí:* it comes from Pegu* and Ceylon, and less frequently from the north.

### The rhombohedral Emerald.

p. *zamarúd;* g. σμαραγδος; s. *markat;* h. *panna.*

The mines of this gem are stated in the Persian works to be situated in the "extreme west," in Barbary, and the upper parts of Egypt. It bears a higher value in India, on account of its entirely foreign origin; it is soft and seldom free from flaws, sp. gr. 2.70. The medical and talismanic properties of the emerald are, averting bad dreams, giving courage, curing palsy, cold, and bloody flux. There is a close connection between the *zamarúd* and the *zabarjad*. Zakarya says, the names are synonymous, and that the true color of the *emerald* is a *brilliant yellow*, (chryso-beryl?) adding on the authority of Aristotle, that it is frequently met with in gold mines.—Mahomed of Berar says, that "the *zabarjad*, although reckoned the best kind of emerald, is, in fact, another stone of higher value, and now scarce." The *Khawás-ul-hejár* describes it as possessing none of the qualities of the emerald, and of an inferior greenish color. The name of *zabarjad* is therefore probably applied indiscriminately to varieties of the beryl, the chrysolite, and the topaz†.

As no separate mention is made of the topaz, it must be considered as really classed in the same family with the emerald and *za-*

* *Taht-ul-Suráa*, mentioned in a former page, may be a corruption of *Syriam* in Pegu, the great mart for spinelles and *yaqúts* from the Capellan mountains.

† The topaz of the ancients is supposed to have been the chrysolite of moderns, and vice versâ. Pliny classes it among his *gemmis viridibus non translucentibus.* "Egregia etiammum topazio gloria est suo virenti genere."

*barjad.* This may be easily accounted for by the similarity of their prismatic crystallization: beryl or aquamarine, a variety of emerald, passes from green into a yellow color; and the striated prisms of topaz pass from a deep golden yellow to a pale green color. Their difference in specific gravity and chemical composition could not be known to a lapidary; their hardness is nearly the same, and they occur in the same mines in Egypt and elsewhere: indeed the term beryl was applied to both by Werner. The aqua marina or beryl is called *berúj:* specimens shewn me had a specific gravity 2.70. The Indian name for topaz is *púkhraj*, whence has been taken the modern Arabic appellation of topaz, *buszák.*

### The Turquois.

P. *firozeh*;* G. καλλαις; S. *péroj?*

The name *Firozeh* is said in the *Jawáhir-nameh* to have been given to this stone by Firoz Shah, but this must be matter of doubt; as also whether the Sanskrit synonyme in Hunter's Dictionary, *péroj*, is not a corruption of *berúj*, beryl, quite a different stone. From the localities and from the characteristics of the two varieties in the books before us, it might be conjectured, that the two species of this mineral known to European mineralogists, as the *calaite*, or mineral turquois, and the *odontolite*, or bone turquois, are equally familiar to the Persian jewellers, under the epithets of *Abu-Is'haqi* and *Badakshání.*

The *Abu-Is'haqi*, (father of Isaac,) or genuine turquois, is the produce of the mines of *Ansar*, near *Nishapár*, in Khorasan, (the same place mentioned as *Michebourg*, in Tavernier's Travels in India.) All authorities concur, that these are the only turquois mines in the world: the stones are said to vary from pale blue to green and white, but all except the azure are worthless. A curious fact is mentioned also, which, from the nature of the mineral† may be readily believed, though it has not been observed in Europe: "the real blue turquois of *Nishapúr* changes its color when kept near musk or camphor, also from the dampness of the ground, as well as from exposure to the fire‡; the inferior stones become discolored even without this test," by gradual decomposition or efflorescence. The *Khawás-ul-hejár* makes the clearness or dulness of the turquois vary according to the atmospheric changes. "It brightens the eyes; is a remedy for ophthalmia and bites of venomous animals; it is used in enamelling sword handles, &c."

* *Firozeh nakis*, an inferior turquois, is enumerated amongst the mineral products of *Tibet*, by *Abdul Kadir Khan*, in the History of Cashmir before quoted.

† Vide Gleanings in Science, II. 375.

‡ Pliny also remarks of the *Callais;* "quæ sunt earum pulchriores, oleo, unguento et mero colorem deperdunt."

"The *Badakshání* turquois essentially differs from the *Nishapúri* in being able to withstand the heat of a fire for ten days without alteration: for this quality it is much esteemed, although in other respects not so good as the produce of *Ansár*."

Now the *calaite*, which contains 18 per cent. of water, would be entirely destroyed by such an operation, while the *bone turquois* is actually made in many places, by exposure to the fire of fossil bones impregnated with iron; and the fossil bones brought from the north of the Himalayan range, when exposed to a red heat, are found to assume the very appearance of *odontolite* :* it is possible, therefore, that a supply of this artificial gem may find its way into Persia through Balkh, and take its name from that country as its known market.

Arguments are not wanting on the other hand to shew that the *Badakshani* turquois is nothing more than *lapis-lazuli*, or *lájaward*, and the descriptions of the two are mixed up together in the books before us, like those of the emerald and topaz.

### Lapis-lazuli.

p. *lájaward;* s. *vaidúrya.*

"The country of *Badakshan* abounds in mountains, and contains several rivers. On the Jihún (Oxus) river, near where the Samarkand road crosses it, is the mine of *lapis-lazuli*. This mineral has different shapes; one, like the egg of a hen, which is covered with thin, soft, and white stony coats, is reckoned the best when pounded, it needs neither washing nor polishing; the others are without covering and must be washed.

"The method of washing is this: first to pulverize it and afterwards to keep it wrapt in silk cloth, besmeared all over with gum sandarach, which should be previously softened in very hot water, and then rubbed over or kneaded with the hands; it is kept in the water for three days, until all the foreign matter has been washed out."

This is exactly the process for manufacturing ultramarine from lapis-lazuli, given in Ure's Chemical Dictionary. "There is also a mine of *lájaward* in that part of Káshán called *kharúd*, or minor. It is difficult to distinguish the *Kashání* from the *Badakshání* mineral, but there is a considerable difference in their value:—the following test is prescribed to recognize them:

"First rub the specimen on a piece of stone without water, and if in doing so it becomes dark, this immediately marks its spuriousness; secondly, put it in the mouth, and afterwards throw it into the fire; when it becomes red, take it out, and if it be not discolored, its

* Vide Journal As. Soc. I. 77. Theophrastus enumerates *fossil ivory* of a lighter or darker colour, as distinct from the sapphire, evidently shewing, that the *odontolite* or bone turquois was intended by ελεφας ορυκτος.

genuineness is established." "The *Káshání* mineral is of an antimonial colour, and is ground up for the painting of glass and porcelain." It is possible that this description may refer to the *zaffre* mineral or sulphuret of cobalt.

This last cursory notice, although foreign to the subject of the precious gems*, arouses a curiosity to know a little more of the contents of the *Ajáib-al-Makhluqát*, and I trust the Raja will continue his labours, confining himself as far as possible to a literal translation of his text.

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## V.—*Proceedings of the Asiatic Society, Physical Class.*

*Wednesday, 15th August,* 1832.

Sir Edward Ryan, President, in the chair.

The proceedings of the last meeting having been approved, the following letters were read.

1. *From Capt. P. Gerard, dated Kotgurh, 23rd July,* announcing, that he had dispatched to the address of the Society, a box containing 164 paper parcels of fossils from the Himalaya, by direction of his brother, Dr. Gerard, their discoverer. He further acquaints the Society, that Dr. Gerard had forwarded from Cabul the first paper of his promised paper on the valley and section of the Spíti, illustrative of these fossils, and that the remainder is expected from Bokhara.

2. *From W. Cracroft, Esq. to Sir E. Ryan, President, dated Chirra Punji, 25th June,* announcing further discoveries of coal beds in the Kasya hills.

The present site is near a place called *Monthan*, where the coal seams occur between the sandstone beds, accompanied as usual with bituminous shale, limestone, and indurated clay; the coal strata altogether are six feet in depth: this locality is so far interesting, because it has been hitherto a desideratum to obtain coal near the foot of the hills equally good with what is found above: the specific gravity of this coal is stated to be only 1.31.

3. *From Dr. Alex. Turnbull Christie, dated Madras, 14th August,* stating, that he had been entrusted by the Geological Society of London with the charge of a series of casts of the fossil bones discovered in Ava by Dr. Crawfurd, for presentation to the Asiatic Society: further, in his own name, begging its acceptance of a small collection of fossil shells from the tertiary formations of France and Italy.

[The package has not yet reached Calcutta.]

4. *From G. Swinton, Esq. Chief Secretary to Government,* communicating a letter from the Rev. Wm. Vernon Harcourt, Secretary of the British Association for the Advancement of Science, by direction of the Central Committee, transmitting a copy of their first Report, and requesting his assistance in extending to India the operation of the plan detailed therein, by the formation of a Committee to correspond with the Association,

* Lapis-lazuli, or azure stone, as has been already remarked, has been supposed to be the *σαπφειρος* of the Greeks.

to promote its objects, and to aid it in carrying on upon a common system, in the most distant parts of the empire, the extensive investigations which it meditates. Copies of the report have been also addressed to Sir E. Ryan, Major Benson, Dr. Christie, Captain Herbert, and Messrs. Calder and Prinsep, who have been requested to coalesce with Mr. Swinton as members of the Indian Committee.

The purport of submitting this letter to the Physical Class was to give publicity to the objects of the British Association, through the circulation of the Society's proceedings, that all who are inclined to undertake any of the trains of investigation pointed out in the published "recommendations*," may know where they may address inquiries, or transmit the results of their observations.

Mr. J. Calder brought to the notice of the Society, as connected with the communication just made known, that since the death of Doctor Voysey, the situation of Geologist and Naturalist to the grand Trigonometrical Survey had remained vacant. He trusted that the present Surveyor General would not lose sight of the great advantages to science of such an appointment, when he should be preparing to continue his grand arc through the unexplored regions of Central Hindústhan.

5. *From Dr. Strong,* with copies of correspondence with Col. Sir Thos. Anburey, Chief Engineer, respecting the pay of the men of the Sapper and Miner Corps employed in the boring experiment.

6. *From G. Swinton, Esq.* forwarding on the part of Colonel Watson specimens of Kasya iron ore, smelted iron, and coal; also some native caoutchouc, manufactured into bottles, and thin sheets, at Chirra Punji.

The latter may become a valuable article for many purposes; the sheets are very thin, pliant, and impervious to air or water.

The coal is of the slaty kind, sp. gr. 1,447, containing volatile matter 36, carbon 41, and a copious white ash, 23 per cent.

7. *From Dr. J. T. Pearson,* submitting his suggestions on the improvement of the Museum of the Asiatic Society.

After some discussion, and a vote of thanks to Dr. Pearson, for the labour he had taken in the consideration of a subject of such vital importance to the Physical branch of the Society,—Messrs. Calder, Troyer, Tytler, Everest, Wilcox, and C. Hunter, in conjunction with the President and Secretaries, were nominated a Committee to report upon the best mode of giving effect to the very desirable plan proposed by Dr. Pearson, previous to coming before the general meeting of the Society, with any application on the subject.

Dr. Pearson exhibited a part of his entomological collection, as an example of what might be effected towards the preservation of specimens in this country.

A fossil was presented by the Rev. R. Everest, supposed to be the vertebræ and ribs of a saurian animal.

*Papers read.*

1. Description of the *Canis primævus* of Nepal, by B. H. Hodgson, Esq.

* These were printed at length in the last number of the Journal.

This interesting paper gives a particular account of the wild dog, of which a notice will be found in Mr. Hodgson's paper on the Mammalia of Nepal published in the present number: it is accompanied by accurate drawings of the animal, and, by way of comparison, of the "chien de rue," and the jackal; and of the skeletons of the head of each.

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## VI.—Scientific Intelligence.

### 1.—*Gold Mines of North America.*

Several new sites of gold ore have, within a few years, been discovered in the United States.

The gold mines of North Carolina, are acquiring importance rapidly, through the improvements in mining introduced by foreign miners. In Virginia also, since 1827, considerable attention has been attracted by the discovery of the precious ore along a belt of country extending through Spotsylvania and the neighbouring counties. In the latter State it is diffused over large spaces, and has not been found sufficiently in mass, except in a few places, to make mining practicable; but in North Carolina the produce has increased from D. 2,500 a year to D. 128,000 in 1829, and 204,000 in 1830.

The mint returns for 1830 state the receipt of gold from "the gold region of the United States," to be D. 466,000, of which D. 212,000 was from Georgia, whence no specimen had ever before been received; D. 24,000 from Virginia and D. 26,000 from South Carolina. The gold country was estimated by Prof. Olmsted, in 1825, at only 1,000 square miles, but it has since been found to be vastly more extensive, and a succession of mines has been discovered in the country east of the Blue Ridge, extending from the river Potomac into the state of Alabama, and ending in Tennessee. The gold works in the counties of Burke and Rutherford are *washings:* the gold is found in small and pure particles mixed with the sand, which lies in deposits, occupying as it were the beds of ancient streams, creeks, &c.

The counties of Mecklenberg, Rowan, Davidson, and Cabarras are the richest in what may be properly called gold *mines;* that is, where the gold is found in *ore*, and distinguishable by the eye, and where it is separated by pounding, and amalgamation with mercury, separating the latter from the gold by distillation in an alembic in the usual manner.

The gold region abounds in quartz, which contains cubical pyrites. These cubes are sometimes decomposed, and the cells thus created are filled with gold. The greatest portion of the metal, however, occurs in veins in slate.

"The best veins of gold are not horizontal, nor often vertical, but have a dip of about 45 degrees. They vary in width from a few inches to several feet: they are not confined to hills at all, but are found also in low lands. These veins are often parallel to each other at unequal distances: their depth in most places has not been ascertained, no shafts having yet pierced lower than 120 feet. The mining required a great deal of skill and experience in economizing the perforations and galleries. There are no less than thirteen different languages spoken at these mines, so speedily have adventurous miners been attracted from Germany, Switzerland, Spain, England, &c. Mills for grinding the ore, propelled by water or by steam, have been erected, and in one establishment alone more than 600 hands are employed. The state of morals among this heterogeneous mass of adventurers is represented to be deplorably bad.

"There is indubitable evidence, that these mines were known and *worked* by the aboriginal inhabitants, or some other people, at a remote period. Many pieces of machinery, which were used for this purpose, have been found. Among them are several *crucibles* of earthen-ware, surpassing in durability the best Hessian crucibles."

We have extracted the substance of the above notice from "*The American Almanac and Repository of Useful Knowledge, for the year* 1832;"—a small octavo volume, which puts to shame all the almanacks of our own country, with the exception of that published under the auspices of the *Society for promoting Useful Knowledge*, by the immense mass of information, calendral, statistical, and physical, which it contains, as well as by the method of its arrangement and the neatness of its execution.

2.—*Analysis of the Copper Ores of Cuba, in the* Cerco *of* Villa Clara. By *Don Ramon de la Sagra.*

The specimens produced belong to the class called green copper (*cobres verdes*), or the carbonate of copper of mineralogists. Some pieces have an earthy appearance, and are soft, friable, and of a whitish-green colour, like certain copper ores of Rio Tinto, in Spain, commonly called "*verde de montana.*" Others are more compact, of a sea green, and sometimes a metallic grey. The oxide of iron with which it is combined is very perceptible to the eye. In order to separate it, I pounded specimens of both descriptions of ore, then distilled and calcined two grammes of each, to ascertain the quantity of water and of carbonic acid, and dissolved the mass in boiling nitric acid: after concentrating the solution, filtering it, washing the residuum, and mixing together the water employed in the washing, I obtained 65 centigrams of precipitate from one mineral, and 38 from the other, by means of liquid ammonia. These quantities of ammoniate of iron corresponding to 32 and 18 centigrams of metal respectively, or 16 centesimals of iron from the former, and 9 from the latter. The whole contents being,

| 1st Specimen. | | 2nd Specimen. | |
|---|---|---|---|
| *Green copper, earthy ore.* | | *Green copper, compact ore.* | |
| Sub-carbonate of copper, (hydrated.) | 64 5 | Sub-carbonate of copper, (bydrated.) | 56 5 |
| Oxide of iron, | 22 5 | Oxide of iron, | 13 0 |
| Silex and earthy residuum, | 13 0 | Earthy residuum, | 30 5 |
| | 100 0 | | 100 0 |

3. *Coal from the district of Guanah, in the island of Cuba, analysed by Don Ramon de la Sagra.*

Texture laminar, of a bright lustre, like the best coal of England—fracture cubical—specific gravity 1.18.

CONTENTS.

| | |
|---|---|
| Carbon or combustible matter of coke, | 60 |
| Betun mineral, (Tar,) | 20 |
| Water, | 4 |
| Incombustible ashes, | 12 |
| Gas, | 4 |
| | 100 |

## VII.—*Progress of European Science.*

### Electricity.

Our journal has hitherto adverted but little to the subject of European science. Our space has been too fully occupied to admit of copious extracts from the scientific periodicals of England, and of the continent; we have confined ourselves to the reprinting of such notices in natural history, as were immediately connected with India. There is consequently a large arrear to bring up in other branches of science, and we must seek the means of doing so rather in the shape of a general review, than of broken and detached extracts. Fortunately, the materials for such a review are for the most part prepared to our hands, in the papers and essays read at the Academie, the Royal Society, and the Royal Institution; and in the annual addresses of the Presidents of other scientific bodies. It is a commendable rule of the French academy, that all works and papers presented, instead of being read at random and at length, are first referred to a *commission*, whose report generally condenses the original matter into a short and lucid abstract, much fitter for perusal before a mixed audience, or by the general class of readers. It is from such sources that we propose to gather our information.

Electricity is one of those invisible agents of nature, to the development of the effects of which attention is at this moment powerfully directed, on account of the discovery of several new phenomena, partly by accident, but chiefly by well-conducted experimental investigation. We shall endeavour to lay before our readers the progress that has been made, in these researches, under two heads:—1st, as connected with chemistry;—and 2nd, as connected with magnetism. The time seems near at hand, when the principle which actuates the *triune* sciences of galvanism, magnetism, and chemistry, will be acknowledged to be one only, under the name of *vis electrica*, subject to as simple and invariable laws as those of the gravitating principle, although like the latter its actual nature may ever remain a mystery to our limited comprehension.

#### 1.—*Electro-Chemistry.*

If anything proves how far we are from a right understanding of the theory of the development of electricity in the voltaic pile, it is the diversity of opinions among philosophers who have especially engaged upon this inquiry.

Volta conceived that the simple contact of two solid conductors, such as the two metals, zinc and copper, produced electricity; and he thought that the liquids interposed between the couplets of the pile served only to transmit the electricity of one to the next.

An observation made in France, by Messrs. Biot and Fred. Cuvier, proved the influence of atmospheric oxigen in the charge of the pile; for having placed it in a receiver full of air, resting upon water, the action of the pile went on diminishing as the oxigen of the air became fixed on the zinc, and finally stopped when nothing but azote was left in the receiver.

Wollaston sought to prove, that the electricity of the pile proceeded from the chemical action of the liquid, interposed between the couplets, on the metals of the latter.

Davy, while admitting the principle of Volta, regarding the development of electricity by contact, recognized the necessity of a chemical action between the liquids and the metals which formed the pile, to produce a charge.

Lastly, M. Nobili starting from the fact, that *an electric current is established in a metallic bar unequally heated*, concludes that, in the pile, the action of liquids on metals develops electricity, because it develops heat, which is unequally communicated to the metals.

The electricity of the pile then has been attributed to three causes, viz. to simple contact, to chemical action, and to heat.

M. Becquerel, for the last ten years, has been engaged in a train of researches which have greatly added to electro-chemical knowledge: it is he who has proved, in an incontestible manner, *the development of electricity in chemical action*, a fact of the highest importance; he has proved besides that, if it be true, as asserted by Davy, that an acid and a solid alkali, become, by contact and before their mutual combination, the first electro-negative, the second electro-positive; it is not true, as the illustrious English philosopher has maintained, that at the moment of combination their electricities neutralise each other, for his experiments prove on the contrary, that *a current of positive fluid then arises from the base to the acid.*

He has shewn besides, that *two liquids of different nature may assume different states of electricity, and thus form the elements of a pile.*

These discoveries, the fruit of very delicate and ingenious experiments, naturally led their author to study the pile, not so much in respect to a general theory, as with a view to an experimental analysis, such as should determine with some precision the causes that influence its charge.

M. Becquerel, in the first chapter of a work submitted to the French academy, treats of such of these causes as are due to chemical action; and his experiments are directed to submit one element of the pile, as much as possible, to the influence of a single cause productive of electricity.

Speaking of the action of different liquids on one another, he gives a sufficient number of experimental results, from which it appears that *an acid conducts itself with a saline solution with which it mixes, as it would with a salifiable base with which it would combine*, that is, *it is positive towards it.* It seems also, that phosphoric acid is positive, relative to the muriatic, nitric, and sulphuric acids; a fact curious enough.

M. Becquerel, in examining the electricity developed by the contactof metals, and of those acids which attack them, or of metals and saline solutions, proves in general, that in the action of an acid on a metal, particularly when this action is not very strong, *the greatest part of the electricity developed, proceeds not from the action of the metal on the acid, but from the mutual action of the solution of salt produced and the free acid.*

Copper, lead, bismuth, zinc, and iron plunged in their respective nitrates become *negative* by the addition of a few drops of nitric acid; while those metals which decompose water, iron, zinc, and manganese, plunged in their respective sulphates, become *positive* as soon as some drops of sulphuric acid are added.

M. Becquerel then takes up the subject of the electric effects produced when two metals, connected by means of the wire of the multiplier, are partly plunged, either in the same liquid or in different liquids communicating together. In this case it is *generally the mutual action of the liquids, and not the action of either liquid upon the metal, which produces the greatest electric effect.*

He observed also, that in a pile formed of copper and zinc, the maximum electro-magnetic effect is obtained when the copper is plunged in nitrate of copper, and the zinc, in sulphate of zinc; because, if the copper and the zinc become, one positive, the other negative,—the nitrate of copper by its contact with the sulphate of zinc becomes positive, whilst the second becomes negative, consequently the sum of electricity developed is then the greatest.

M. Becquerel perceived that one way to preserve electrical effects sensibly constant during a certain interval, in a voltaic element formed of two metals, was to prevent their surfaces from becoming covered with solid deposits : unfortunately the process he adopted to obviate this defect is not of easy application in the ordinary construction of the pile, nor is it explained in the report.

Before entering upon the processes of electro-chemistry that he has employed to produce new chemical combinations, he describes an old experiment by Bucholz, founded on the same principles.

Bucholz, having introduced into a narrow receiver, containing a solution of sulphate of copper surmounted by plain water, a plate of copper, so that its upper part was immersed in the water, and the lower part in the sulphate, observed, that this part became soon encrusted with metallic copper : M. Becquerel supposes that, in this case, the two liquids form a voltaic couple, of which the solution is the positive pole and the water the negative.

When the slip of copper is immersed, a current of positive electricity is established from below upwards ; thus the plate becomes a pile of which the base is negative, and the summit positive ; and as a simple consequence, the copper is transported to the negative pole.

The possibility of thus establishing piles of single pairs formed either of two solids, or of two liquids,—and the property enjoyed by oxigen of travelling quicker than do the acids to the positive pole of these piles, which have always a very feeble tension,—led M. Becquerel to avail himself of electro-chemistry, to obtain several compounds of a remarkable nature, whether from their resemblance to the natural products met with in the strata of the earth, or from their similarity to certain products of the chemist's laboratory. As an example,

He put into a closed tube some concentrated muriatic acid, and a piece of charcoal fixed to a slip of silver by a wire of the same metal ; the open end of the tube was then drawn out to a fine thread with the blowpipe, but not closed. At the end of several months, there were formed upon the lamina of silver, octohedric crystals of chloride of silver, 0.001 metre (0.04 inch) in diameter, which resembled exactly those of nature ; while from the charcoal was disengaged some gas supposed to be carburetted hydrogen. The rationale is as follows : the charcoal and the silver form together a pile, of which the former is the negative pole; hence the hydrochloric acid is decomposed,—the chlorine goes over to the silver with which it combines, while the hydrogen goes to the negative pole. When copper is substituted for silver, protochloride of copper is deposited in tetrahedric crystals.

Protoxides of copper, of lead, the oxide of zinc, &c. have all been obtained in crystals by the following process : taking copper as an example : in a glass tube, a convenient portion of deutoxide of copper is placed, and a saturated solution of nitrate of copper, along with a slip of the same metal which ought to touch the deutoxide. The tube is then hermetically sealed ; the nitrate in contact with the deutoxide gradually passes to the state of insoluble subnitrate : then the lower part of the solution being less charged than the upper, acquires negative electricity, whilst the upper becomes positive ; a current commences therefore from above downwards, so that the lamina is itself a pile, of which the positive pole is below, and the negative above. It is natural, therefore, that the protoxide of copper should transport itself and crystallize on the upper extremity of the lamina.

Finally, M. Becquerel has formed double chlorides, bromures, iodures, sulphurets and cyanurets, crystallized under the influence of electro-chemical forces. Thus to obtain a double chloride of copper and sodium, he takes a tube curved

like the letter V. He fills the curved part of it with *kaolin*, (porcelain clay,) previously boiled in acid; he then fills one branch of the syphon, with a solution of chloride of sodium—the other with one of nitrate of copper; lastly, a bit of copper-wire is put into each, and the openings are closed with mastic.

The two solutions upon their gradual mixture acquire different states of electricity: the wire plunged in the nitrate becomes negative, while that in the chloride remains positive; the nitrate of copper is decomposed, and its metal deposited upon the wire which is plunged into it, whilst the oxigen of the base transports itself to the positive wire plunged in the chloride and thus produces a *double* chloride, because a portion of this chlorine unites with the metallic wire, and the chloride of copper resulting combines with the chloride of sodium. The greater part of the nitric acid remains free in the branch where the copper is deposited.—*Journal des Savans, Jan.* 1831.

In the proceedings of the Royal Institution of February last, we also find the following notice of some experiments made by Dr. Richie, on the laws of action in an elementary galvanic battery, and their application to the laws of a compound battery.

"Dr. Richie's experiments proved, that Volta's electro-motive theory was incorrect, and that decided voltaic effects could be produced by one metal and one fluid. He attempted to account for the deflection of the needle and the decomposing powers of an elementary battery, without supposing any *actual* transfer of the electric fluid from the zinc through the fluid to the copper plate, by the definite arrangement of the molecules of water. He shewed that the electro-magnetic effects are nearly inversely as the square roots of the distance between the plates: and that the effects of two unequal batteries were nearly as the square roots of their lengths. When their lengths were much extended, as is the case in an elementary battery, the increase of power begins to deviate from this law, and to verge to a limit beyond which any increase in the number of plates would diminish their powers."

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### II.—*Electro-Magnetism.*

In the *Philosophical Transactions* for 1831, is an essay by Mr. Barlow, on the Probable Electric Origin of all the Phenomena of Terrestrial Magnetism, which gives so clear a view of the progress of researches on this most interesting branch of electricity, that we regret our limits do not allow us to present it to our readers at length: the following is a summary of its contents.

The facts relative to terrestrial magnetism collected during the scientific travels of M. Humboldt were the first to awaken inquiry as to the laws of terrestrial magnetism. The difficult task of reducing that eminent traveller's results to calculation fell to the lot of M. Biot.

"Considering the earth as a magnet, he assumed an indeterminate distance to represent the distance of its two poles; and then, supposing their power to vary inversely as the square of their distance from the point on which they acted, (a law which had been already established,) he obtained a general expression for the direction of a magnetic needle; he then made his indeterminate distance vary; and comparing at every step his results with those observed, it was found that the nearer the poles were made to approach, the nearer the computed and observed results corresponded; and finally, that the errors were reduced to a minimum when the two poles were coincident, or indefinitely near to each other." This

important result demonstrated that the earth was not a magnet, according to the common property of which the poles are distinct and distant from one another.

The intricate formulæ of M. Biot when simplified, were found to agree with an empyric relation discovered by M. Kraft of Petersburgh, in examining some observations of the magnetic dip in different parts of the world; namely, "*that the tangent of the dip of the needle in any place is equal to double the tangent of the magnetic latitude of that place.*" It followed also from Biot's formulæ, that *the intensity of the dipping needle ought to vary inversely as the square root of four*, minus *three times the square of the sine of the dip; and that of the horizontal needle, inversely as the square root of three*, plus *the square of the secant of the dip:* conditions which have in a great measure been verified, but which call for further confirmation in every quarter of the globe.

These laws are entirely inconsistent with those of a permanent magnetic body; while Mr. Barlow shows, they are the fundamental laws of a body which receives its transient magnetism by induction; and resemble precisely the conditions of the iron sphere upon which his experiments were made in 1819*, where the remarkable fact was pointed out, that all the magnetic power of an iron sphere resides on its surface.

Still an insuperable obstacle seemed to oppose itself to any rational hypothesis, relative to the cause of the earth's magnetic power. At that time only one means of inducing magnetism was known, which was by the approximation of a permanent magnet to a ball, or mass of simple iron, and of one or two other metals; the cause, therefore, remained inexplicable, until the important discovery of M. Oersted, that *a wire conducting an electric current was during the interval of transmission in a state of magnetic induction.* A number of interesting facts were immediately brought to light, founded upon this grand discovery, by the researches of M. Ampere, Biot, and Faraday. Mr. Barlow sought in it directly for the explanation of the phenomena of the iron sphere; and after many experiments to prove, that *the force of each particle of the galvanic wire on each particle of the needle varies inversely as the square of the distance*, and that the nature of the force is tangential, that is, such as would place a needle always at right angles to the direction of the wire, (facts more fully elicited by M. Ampere's investigations,) he applied it to the construction of a globe which should exhibit the whole phenomena of terrestrial magnetism as due to the superficial action of galvanic currents. This idea was put to the test of experiment with the most satisfactory results. A wooden globe of 16 inches diameter was encircled by a series of coils of wire in circles representing the latitude lines of the actual globe or parallels to the earth's magnetic equator. When the two ends of the coils of wire were connected with the two poles of a galvanic battery, a state of magnetism was induced precisely resembling the state of things on the earth: and a small needle placed in any situation upon its surface assumed the dip and variation corresponding to the locality.

Thus Mr. Barlow was the first to prove the existence of a force competent to produce all the phenomena of terrestrial magnetism, without the aid of any body usually called magnetic; and indeed it had been shewn by M. Biot's laws, that no position of a single magnet, nor the arrangement of any number of such bodies within the globe, could cause an exhibition of the same phenomena, particularly as relates to the intensity of the needle's magnetism.

As far as the discovery of M. Oersted went, however, it did not appear how a system of electrical currents could have existence on the earth, without a particu-

* Essay on Magnetic Attraction, 1820.

lar arrangement of metals, acids, and conductors. This difficulty was removed by a subsequent discovery of Professor Seebeck, of Berlin, only inferior in importance to the first, that the mere application of heat to a circuit composed of two metals was competent to produce the same development of galvanic and magnetic effects as those of the pile. Thus if instead of the coil of conducting wire on the globe above described, each parallel were made complete in two metals, all the phenomena might be represented by the application of heat only. A still farther simplication has been made by Mr. Sturgeon of Woolwich, who has produced all the effects of a compound metallic combination, with a rectangle of bismuth only, *unequally heated:* a fact according wonderfully with the galvanic plate, described in M. Becquerel's experiments, of a single metal acted on by saline solutions of irregular composition.

"M. Seebeck's discovery brings us therefore," says Mr. Barlow, "a step nearer to our object, by referring us to the sun as the great agent of all these phenomena, and indeed only one link seems wanted to connect together the chain, and thereby to reduce to simple and intelligent principles what has hitherto been considered amongst the most mysterious laws of nature."

Since the publication of Mr. Barlow's paper, Mr. Faraday has taken up the subject of *volta-electric* and *magneto-electric induction*, and although we have not a full account of his experiments, the notice of them in the report of the Royal Institution already prepares us for a train of highly curious results; indeed, the grand desideratum of converting magnetism into electricity seems in his skilful hands on the points of attainment.

"If two wires (A and B)be placed side by side, but not in contact, and a voltaic current be passed through A, there is instantly a current produced by induction in B, in the opposite direction. Although the principal current in A be continued, still the secondary current in B is not found to accompany it, for it ceases after the first moment; but when the principal current is stopped, then there is a second current produced in B, in the opposite direction to that of the first produced by the inductive action, or in the same direction as that of the principal current. These induced currents are so momentary that their effect on the galvanometer is scarcely sensible; but when they are passed through helices containing unmagnetised steel needles, they convert them into magnets.

If a wire connected at both extremities with a galvanometer be coiled, in the form of a helix, round a magnet, no current of electricity takes place in it. This is an experiment which has been made by various persons, hundreds of times, in the hope of evolving electricity from magnetism, and, as in other cases in which the wishes of the experimenter, and the facts, are opposed to each other, has given rise to very conflicting conclusions.—But if the magnet be withdrawn from or introduced into such a helix, a current of electricity is produced whilst the magnet is in motion, and is rendered evident by the deflection of the galvanometer. If a single wire be passed by a magnetic pole, a current of electricity is induced through it, which can be rendered sensible."

Thus is obtained the result so long sought after, *the conversion* of magnetism into electricity; whenever a metallic body moves near a magnet, so as to intersect the magnetic curves, electricity is evolved, according to very simple laws. Similar results have been obtained even with the magnetism of the earth; on these subjects Mr. Faraday had recently read a paper before the Royal Society, and he intended (in February) bringing them forward experimentally at the evening meetings of the Royal Institution.

The induction of electricity by the momentary passage of a magnetic pole, so analogous to that of the induction of magnetism by a current of electric fluid, leads at once to the consideration of another branch of magnetic phenomena which originated with Mr. ARAGO, and has since been studied assiduously by Messrs. HERSCHEL, CHRISTIE, BARLOW, and STURGEON, and others, namely, the magnetic effects of metallic plates in rotation, with which we think should be classed, the practical methods of magnetising steel bars, by the motion of magnets over them.

That magnetism existed in brass had been pointed out by Mr. BARLOW in 1823, but the magnetic force in most metals except iron, nickel, and cobalt was far too feeble to be detected by the simple application of the most delicate needle. Mr. ARAGO judiciously applied the principle of the *magnetic momentum* generated by the rapid motion of discs of these metals, and demonstrated that all possessed magnetic energy in various degrees*. The novel phenomenon of a magnetic needle rotating on its pivot by simply placing it above a revolving plate of copper, had something in it so fascinating, and presented so striking a similitude to the electro-magnetic rotations then familiar to philosophers, that for a while it was doubted whether or not the revolving plate possessed electric properties. Another mode of solving the problem was, that the copper plate, like all ferruginous bodies, actuated the needle through what is called *induced* magnetism by the influence of the earth, and that the needle was put into motion by a rapid succession of transient magnetic poles induced in the plate. When however it was found that light copper discs would of themselves rotate when suspended over a revolving horse-shoe, or other powerful magnet, it occurred that all the phenomena emanated from the action of the magnet employed, exciting transient polarity in the metals under examination.

Mr. STURGEON, from whose paper the foregoing facts are drawn, was from the want of an adequate hypothesis led to examine the distribution of magnetic polarity in metallic discs, by making them revolve or oscillate between the poles of a horse-shoe magnet, and trying the conditions of various parts of the plate by a small dipping needle. The number of vibrations performed by a thin copper disc under the influence of a magnet, were reduced even five-fold when compared with its free vibrations in air.

This subject is still under investigation, and will doubtless receive fresh elucidation from the able men engaged upon it: we have already found that magnetism is but another name for electricity, and shall soon know how to elicit it from every substance, and perhaps to draw benefits as important in mechanical as the polarity of the needle is in nautical science. What can be more wonderful than the prodigious mechanical force set in action by what appears a very inadequate cause,—the elector-magnet, an instrument now familiarly known, in which a coil of wire is wound round a horse-shoe of soft iron, and connected by its two extremities with two small plates of zinc and copper. One of these instruments, constructed by Mr. WALSH of Woolwich, was exhibited at the evening meetings of the Institution, which when the plates were dipped in weak acid, sustained a weight of between 300 and 400 pounds, though before the application of the voltaic power it did not support an ounce.

The last fact to be noted in the progress of electrical knowledge, is the production of sparks from the magnetic needle in Italy: Signor NOBILI's announcement has been confirmed by Mr. JAMES D. FORBES' experiments, before the Edinburgh Royal Society, in April, 1832. And the power of drawing sparks from the natural magnet is now established. All we know as yet of the procedure is that, it "rests upon the recent discoveries of our distinguished countryman Mr. FARADAY."

* W. Sturgeon, Phil. Mag. April, 1832.

*Meteorological Register, kept at the Surveyor General's Office, Calcutta, for the Month of August, 1832.*

| Days of the Month. | Minimum Temperature observed at sunrise. | | | | | Maximum Pressure observed at 9h. 50m. | | | | | Max. Temp. and Dryness observed at 2h. 40m. | | | | | Minimum Pressure observed at 4h. 0m. | | | | | Observations made at sunset. | | | | | Observations in Calcutta, 10h. 30m. P. M. | | | | | Rain Gauge, No. 1. | Rain Gauge, No. 2. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Barometer reduced to 32°. | Temper. of the air. | Depres. of M.B.Ther. | Wind. | Aspect of the sky. | Barom. red. to 32°. | Temper. of the air. | Depres. of M.B.Ther. | Wind. | Aspect of the sky. | Barom. red. to 32°. | Temper. of the air. | Depres. of M.B.Ther. | Wind. | Aspect of the sky. | Barom. red. to 32°. | Temper. of the air. | Depres. of M.B.Ther. | Wind. | Aspect of the sky. | Barom. red. to 32°. | Temper. of the air. | Depres. of M.B.Ther. | Wind. | Aspect of the sky. | Barom. red. to 32°. | Temper. of the air. | Depres. of M.B.Ther. | Wind. | Aspect of the sky. | | |
| 1 | 29,389 | 79,7 | 1,2 | cm. | rn. | ,440 | 84, | 3,5 | n. | cu. | ,346 | 89,7 | 5,5 | s. | cu. | ,332 | 86, | 3,5 | n. | cu. | ,307 | 81,8 | 2,1 | n. | n. | ,397 | 80,5 | 3,3 | w. | cus. | 1,72 | 1,45 |
| 2 | ,321 | 79,5 | 1,8 | n. e. | do. | ,391 | 86, | 5,3 | n. e. | do. | ,321 | 89,3 | 7,8 | u. e | do. | ,325 | 83, | 3,5 | n. e. | n. | ,328 | 81, | 1,8 | n. e. | cis. | ,407 | 82,0 | 2,8 | e. | n. | 0,32 | 0,21 |
| 3 | ,357 | 79,7 | 1,5 | do. | cy. | ,415 | 83,8 | 3,9 | do. | cus. | ,359 | 82,5 | 2, | s. | rn. | ,341 | 84,3 | 3,3 | s. | cus. | ,357 | 82, | 1,8 | s. | cu. | ,412 | 80, | 1,9 | e. | cl. | 0,64 | 0,28 |
| 4 | ,411 | 79, | 1,3 | s. e. | rn. | ,469 | 85, | 5,1 | s. e. | cu. | ,421 | 84,5 | 4,8 | s. e. | cis. | ,413 | 83,3 | 3,8 | e. | cis. | ,434 | 81,5 | 2,3 | s. e. | cis. | ,514 | 82,2 | 3,6 | e. | cis. | 0,14 | 0,05 |
| 5 | ,505 | 80, | 1,5 | s. | cu. | ,550 | 85,5 | 5,8 | s. | do. | ,449 | 88,5 | 7,6 | do. | cu. | ,437 | 87, | 6,3 | s. e. | do. | ,463 | 84, | 4,3 | s. | ci. | ,534 | 83, | 3,2 | s. w. | cis. | | |
| 6 | ,454 | 79, | 1,8 | s. w. | rn. | ,492 | 82, | 2,5 | s. w. | do. | ,419 | 83, | 3, | s. w. | u. | ,411 | 82,3 | 2,8 | s. w. | do. | ,405 | 80, | 1,8 | s. w. | cis. | ,448 | 81,2 | 2,2 | s. w. | cis. | 0,38 | 0,28 |
| 7 | ,416 | 80, | 2,3 | do. | cu. | ,451 | 84, | 3,8 | s. | cus. | ,355 | 81,3 | 2,8 | do. | cis. | ,335 | 80,7 | 2,2 | do. | n. | ,343 | 78,7 | 1, | do. | rn. | ,358 | 80, | 1,8 | s. w. | rn. | | |
| 8 | ,389 | 77, | 1,8 | do. | rn. | ,411 | 81,5 | 2,6 | s. w. | rn. | ,410 | 81,8 | 2,1 | s. e. | do. | ,410 | 81,7 | 2,2 | s. e. | cis. | ,405 | 80,5 | 1,8 | s. e. | cus. | ,526 | 80, | 2,1 | w. | rn. | 2,63 | 2,33 |
| 9 | ,551 | 77, | 1,3 | s. e. | do. | ,599 | 80,5 | 2,3 | e. | do. | ,550 | 83, | 3,1 | e. | cus. | ,524 | 84,5 | 3,6 | e. | do. | ,524 | 81, | 1,8 | do. | ci. | ,624 | 82, | 3,0 | e. | cu. | 3,00 | 2,83 |
| 10 | ,604 | 80, | 1,5 | do. | cu. | ,669 | 87,5 | 5,8 | s. e. | cu. | ,601 | 89,3 | 8,3 | s. e. | cu. | ,572 | 87,5 | 7,5 | s. e. | cu. | ,572 | 83,5 | 4,3 | do. | cis. | ,653 | 83,1 | 3,8 | cm. | ci. | 0,40 | 0,20 |
| 11 | ,606 | 81,7 | 1,5 | s. | do. | ,646 | 86,5 | 7, | s. w. | do. | ,537 | 90,5 | 9,8 | w. | do. | ,523 | 89,5 | 8,3 | do. | do. | ,519 | 82, | 3,3 | do. | n. | ,588 | 83,4 | 4,5 | s. w. | cis. | | |
| 12 | ,508 | 81, | 2,3 | n. w. | ci. | ,558 | 82,7 | 3,5 | n. w. | cus. | ,445 | 84,7 | 4,8 | n. w. | cus. | ,435 | 83, | 2,8 | s. w. | cis. | ,427 | 82, | 1,8 | s. w. | cis. | ,504 | 81,4 | 3,6 | s. w. | ci. | 0,37 | 0,25 |
| 13 | ,438 | 79,5 | 1,6 | n. e. | cy. | ,475 | 86, | 5,5 | w. | cu. | ,398 | 87,5 | 5,6 | u. e. | cis. | ,349 | 86,3 | 4,6 | do. | do. | ,368 | 85,3 | 4,4 | do. | cu. | ,463 | 83,8 | 4,4 | s. w. | ci. | | |
| 14 | ,422 | 81,5 | 2, | do. | cu. | ,481 | 87, | 4,8 | u. e. | do. | ,401 | 92,5 | 10,6 | do. | ci. | ,399 | 87, | 7,1 | s. e. | cus. | ,415 | 85, | 4,3 | cm. | ci. | ,499 | 84,6 | 5,3 | w. | do. | 0,22 | 0,13 |
| 15 | ,420 | 81, | 1,8 | do. | do. | ,458 | 82,5 | 3,3 | do. | do. | ,367 | 90,5 | 9,8 | do. | cu. | ,342 | 90, | 9,2 | n. e. | cu. | ,381 | 85,5 | 5,8 | n. e. | cu. | ,390 | 81,5 | 4,3 | e. | cl. | 0,14 | 0,09 |
| 16 | ,411 | 79,7 | 1,8 | do. | cy. | ,449 | 84,7 | 5,2 | do. | do. | ,355 | 87,5 | 6,3 | do. | do. | ,335 | 88, | 7, | do. | do. | ,366 | 85, | 6,3 | do. | do. | ,416 | 82,3 | 5,3 | n. e. | n. | 0,21 | 0,15 |
| 17 | ,394 | 81, | 2,8 | do. | cu. | ,473 | 84,3 | 3,8 | do. | do. | ,432 | 89,3 | 8,4 | s. | do. | ,430 | 89, | 7,5 | s. | ci. | ,443 | 85,5 | 5,8 | s. | ci. | ,539 | 83,2 | 5,7 | n. | cl. | | |
| 18 | ,502 | 80,7 | 1,8 | s. e. | do. | ,548 | 87, | 6, | s. e. | cus. | ,468 | 88,5 | 6, | s. e. | cis. | ,440 | 87,8 | 6,1 | s. e. | cis. | ,433 | 85, | 4,3 | s. e. | cis. | ,502 | 84,2 | 3,2 | cm. | do. | | |
| 19 | ,448 | 81,7 | 2, | s. w. | do. | ,496 | 85,5 | 7,3 | s. w. | cu. | ,425 | 81,5 | 2,6 | cm. | rn. | ,413 | 81,7 | 2,8 | s. | cy. | ,400 | 81, | 2,3 | do. | rn. | ,508 | 82, | 3,1 | s. w. | n. | | |
| 20 | ,466 | 81, | 2,1 | do. | cus. | ,547 | 79, | 1,8 | do. | rn. | ,471 | 81, | 2,8 | s. | cis. | ,472 | 82,3 | 3,4 | s. e. | cis. | ,477 | 83, | 2,8 | do. | cis. | ,554 | 81,8 | 3,8 | s. | cl. | 0,24 | 0,14 |
| 21 | ,547 | 81, | 1,8 | s. | cu. | ,615 | 87,3 | 6,3 | s. | cu. | ,530 | 87,3 | 6,6 | do. | cu. | ,528 | 86,7 | 5,2 | s. | do. | ,533 | 85,3 | 5,4 | s. | do. | ,605 | 84, | 3,0 | do. | do. | | |
| 22 | ,555 | 81,5 | 2,6 | do. | ci. | ,624 | 87, | 6,5 | do. | cus. | ,510 | 88,7 | 7,7 | do. | cis. | ,510 | 88, | 6,8 | do. | ci. | ,499 | 83, | 4,5 | do. | cu. | ,575 | 85,6 | 5,6 | s. w. | cus. | | |
| 23 | ,550 | 81,5 | 2,3 | s. w. | cu. | ,627 | 78,5 | 1,3 | cm. | rn. | ,518 | 78,7 | 3,2 | w. | do. | ,479 | 79,7 | 2,2 | w. | cu. | ,505 | 79,3 | 1,8 | w. | rn. | ,577 | 79,6 | 1,6 | n. w. | rn. | 2,97 | 2,65 |
| 24 | ,510 | 78, | 1,5 | n. e. | rn. | ,569 | 83, | 3,5 | n. w. | cu. | ,444 | 88, | 6,5 | do. | cu. | ,436 | 88, | 7, | do. | do. | ,437 | 84, | 3,5 | do. | cu. | ,523 | 79, | 1,9 | s. e. | do. | 0,62 | 0,54 |
| 25 | ,431 | 79,3 | 1,4 | do. | cus. | ,481 | 85,7 | 4,9 | n. e. | do. | ,385 | 90,7 | 7,5 | n. e. | do. | ,367 | 90,3 | 8,6 | n. e. | do. | ,396 | 84, | 3,3 | n. | do. | ,468 | 82, | 3,0 | cm. | cu. | | |
| 26 | ,408 | 80,3 | 1,6 | s. e. | do. | ,450 | 87, | 6,5 | s. e. | do. | ,371 | 88,9 | 7,4 | s. w. | do. | ,357 | 85,7 | 4,5 | s. e. | cis. | ,384 | 84,7 | 4, | s. e. | cis. | ,460 | 83,2 | 3,8 | n. | do. | 0,58 | 0,45 |
| 27 | ,434 | 79, | 1,1 | cm. | n. | ,476 | 81,8 | 2,1 | do. | do. | ,438 | 84,7 | 5,2 | do. | cus. | ,438 | 84, | 4, | do. | cu. | ,487 | 82, | 1,8 | do. | ci. | ,553 | 82,2 | 2,9 | e. | do. | 0,38 | 0,26 |
| 28 | ,533 | 79,7 | 1, | s. | do. | ,602 | 86, | 4,8 | e. | do. | ,534 | 85,5 | 5,5 | s. | do. | ,530 | 84,7 | 3,2 | s. | cis. | ,523 | 82,5 | 2,8 | cm. | cus. | ,598 | 82,2 | 2,0 | s. | rn. | 0,68 | 0,55 |
| 29 | ,564 | 79,5 | 1,3 | s. e. | rn. | ,614 | 83, | 3,1 | s. e. | cus. | ,526 | 88, | 6,3 | s. e. | ci. | ,513 | 85,7 | 4,8 | s. e. | do. | ,528 | 81,7 | 3,5 | s. e. | rn. | ,576 | 83,5 | 4,0 | u. e. | cu. | 0,37 | 0,28 |
| 30 | ,568 | 81,3 | 2,4 | s. w. | cu. | ,562 | 80, | 1,5 | cm. | rn. | ,444 | 85,7 | 6,5 | s. w. | cis. | ,444 | 85,5 | 4,8 | s. w. | cus. | ,445 | 82,5 | 2,8 | s. w. | cus. | ,529 | 83,2 | 2,7 | cm. | cl. | 0,34 | 0,34 |
| 31 | ,465 | 79,7 | 2, | n. | do. | ,529 | 86, | 5,1 | n. | ci. | ,412 | 90, | 7,3 | n. w. | cu. | ,406 | 87,7 | 5,5 | n. | do. | ,406 | 83,5 | 2,3 | n. | u. | ,512 | 83,2 | 3,0 | do. | do. | | |
| Mean, | 29,468 | 80,0 | 1,8 | | | ,522 | 84,2 | 4,3 | | | ,440 | 86,5 | 5,9 | | | ,427 | 85,5 | 5,0 | | | ,436 | 82,9 | 3,2 | | | ,510 | 82,2 | 3,4 | | | 1644 | 1346 |

*Abreviations.* In the column "wind," small letters have been used instead of capitals; *cm.* means *calm.* In the column "aspect of the sky," *cy.* is *cloudy; cl. clear; rn. rain, ci. cirrus; cu. cumulus; cs. cirro-stratus; cus. cumulo-stratus; cc. cirro-cumulus; n. nimbus.*